After Sales Technical Documentation

SERVICE MANUAL

[NMP Part No. 0275066]

NHE–5 SERIES CELLULAR PHONE

(FOR USE ON THE GSM NETWORK)

NOKIA
MOBILE PHONES

Original 05/97

After Sales Technical Documentation

NHE–5 Last update: 05/97

Original 05/97

After Sales Technical Documentation

NHE–5 SERIES CELLULAR PHONES
SERVICE MANUAL
OVERALL CONTENTS

NHE–5 Series Core Transceiver booklet comprising

Chapter 1:	**Foreword**
Chapter 2:	**Technical Information**
Chapter 3:	**Transceiver Overview**
Chapter 4:	**System Module GT8**
Chapter 5:	**System Module GT7**

Appendices to Core Transceiver booklet

Appendix 1 – Transceiver NHE–5NX
Appendix 2 – Transceiver NHE–5NY
Appendix 3 – Transceiver NHE–5NA
Appendix 4 – Transceiver NHE–5SX
Appendix 5 – Transceiver NHE–5SY
Appendix 6 – Transceiver NHE–5SA
Appendix 7 – Transceiver NHE–5NB

Other booklets comprising

Service Software Instructions
Tuning Instructions
Service Tools
Dissassembly/Troubleshooting Instructions
(PHF–5) Compact Handsfree Unit
Non–serviceable Accessories
Installation Instructions

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NHE–5 GSM SERVICE MANUAL ORDER FORM

To the .....(Business Area)

Please indicate on the form below the booklets required for your Service Manual and the total number of manuals required.

Booklet	NMP Part Number	Booklet reqd: Y or N
NHE–5 SERIES SERVICE MANUAL – COMPLETE	0275066	
NHE–5NX Appendix 1		
NHE–5NY Appendix 2		
NHE–5NA Appendix 3		
NHE–5SX Appendix 4		
NHE–5SY Appendix 5		
NHE–5SA Appendix 6		
NHE–5NB Appendix 7		
Service Software Instructions		
Tuning Instructions		
Service Tools		
Disassembly/Troubleshooting Instructions		
Basic Handsfree Unit PHF–5		
Non–serviceable Accessories		
Installation Instructions		

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Chapter 1

FOREWORD

CHAPTER 1 – FOREWORD

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Introduction

Service Manual Structure

The service manual is structured as a series of stand–alone booklets. The 'core' service manual consists of the following:

NHE–5 series Transceiver booklet comprising

Chapter 1:	Foreword
Chapter 2:	Technical Abstract
Chapter 3:	Transceiver Overview
Chapter 4:	System Module GT8

Appendix to the Transceiver booklet covering all specific variants comprising:

Chapter 1:	Foreword
Chapter 2:	Transceiver Variant
Chapter 3:	Quick Guide

The accessory booklets comprise an overview; separate booklets covering those accessories deemed to be serviceable; and a booklet covering the remaining (non–serviceable) accessories.

Accessory Overview

PHF–5 Basic Handsfree Unit

Non–serviceable Accessories

Other booklets available are:

Installation Instructions

Service Software Instructions

Disassembly Instructions

Troubleshooting Instructions

Tuning Instructions

This section of the service manual (the NHE–5 series Transceiver booklet) describes those areas of the NHE–5 series handportable telephone which are common to all variants. This booklet includes technical information; a technical overview of the transceiver plus detailed descriptions of the main modules and associated parts lists.

The Service Manual is intended for use by qualified service personnel only.

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Ltd should be notified in writing.

Please state:

Title of the Document + Issue Number/Date of publication

Latest Amendment Number (if applicable)

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After Sales Technical Documentation
PO Box 86
24101 SALO
Finland

Warnings and Cautions

1 CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI–SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.

2 THE HANDPORTABLE TELEPHONE MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES EG PETROL STATIONS, BLASTING AREAS ETC. PERMISSION MUST BE OBTAINED TO USE THE PHONE IN AIRCRAFT.

3 OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.

Cautions

1 SERVICING AND ALIGNMENT MUST BE UNDERTAKEN BY QUALIFIED PERSONNEL ONLY.

2 ENSURE ALL WORK IS CARRIED OUT AT AN ANTI–STATIC WORKSTATION AND THAT AN ANTI–STATIC WRIST STRAP IS WORN.

3 ENSURE SOLDER, WIRE, OR FOREIGN MATTER DOES NOT ENTER THE TELEPHONE AS DAMAGE MAY RESULT.

4 USE ONLY APPROVED COMPONENTS AS SPECIFIED IN THE PARTS LIST.

5 ENSURE ALL COMPONENTS, MODULES SCREWS AND INSULATORS ARE CORRECTLY RE–FITTED AFTER SERVICING AND ALIGNMENT. ENSURE ALL CABLES AND WIRES ARE REPOSITIONED CORRECTLY.

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Chapter 2

TECHNICAL INFORMATION

Original 06/96

CHAPTER 2 – TECHNICAL INFORMATION

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Introduction

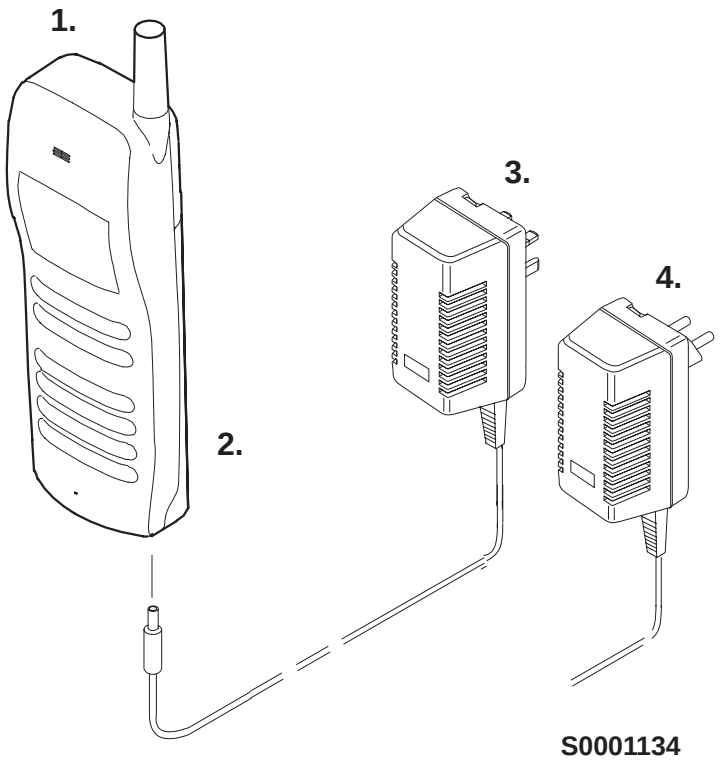
This chapter contains a list of products/modules together with their associated order codes, and details of the performance specifications for the NHE–5 Series Transceiver. The performance specifications are split into general, transmitter and receiver functions.

Product Selection

Handportable

The NHE–5 is a handportable cellular phone for the pan–European GSM network. It is a GSM phase 1 power class 4 transceiver providing 11 power levels with a maximum output power of 2 W.

The basic handportable package offers the user a standard battery pack and travel charger for charging from mains. The package contains the following product:

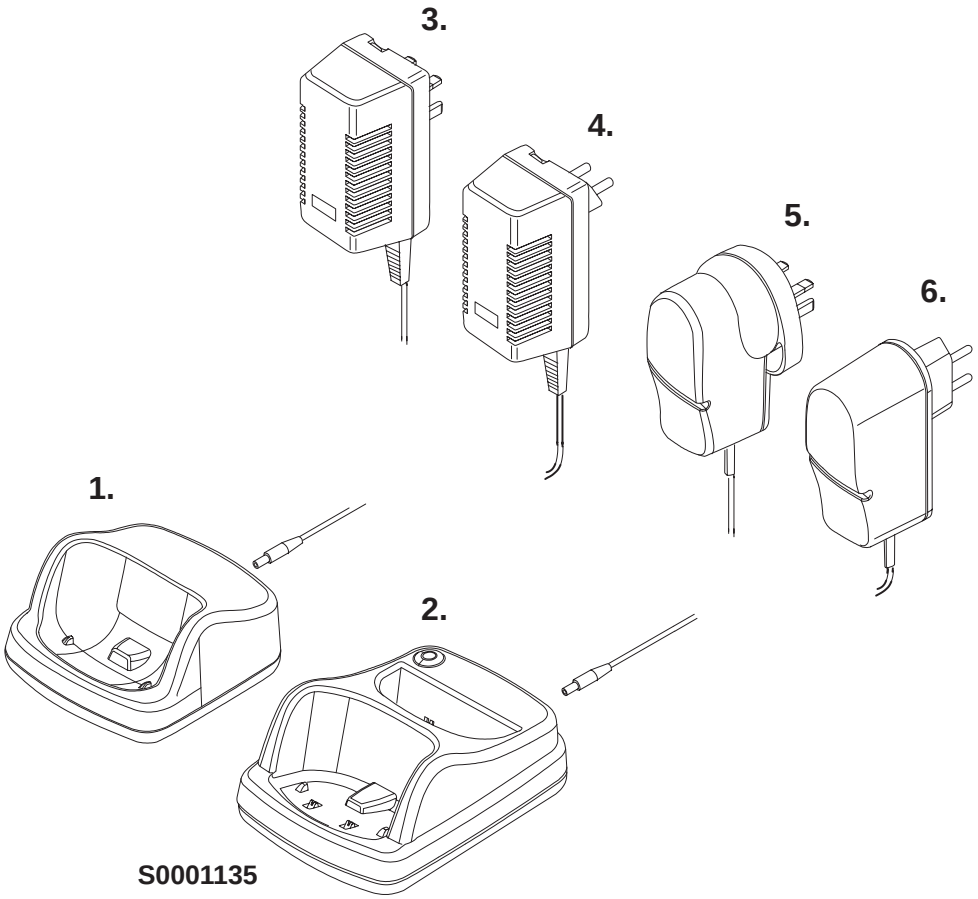


S0001134

Item/name:	Type:	Product code:
1. Handportable (see Variant Appendixes)		
2. Standard battery	BBT–6S	0670117
3. Standard charger (UK plug)	ACH–8X	0675090
– Standard charger (Australia plug)	ACH–8A	
4. Standard charger (Euro plug)	ACH–8E	0675089

Desktop Option

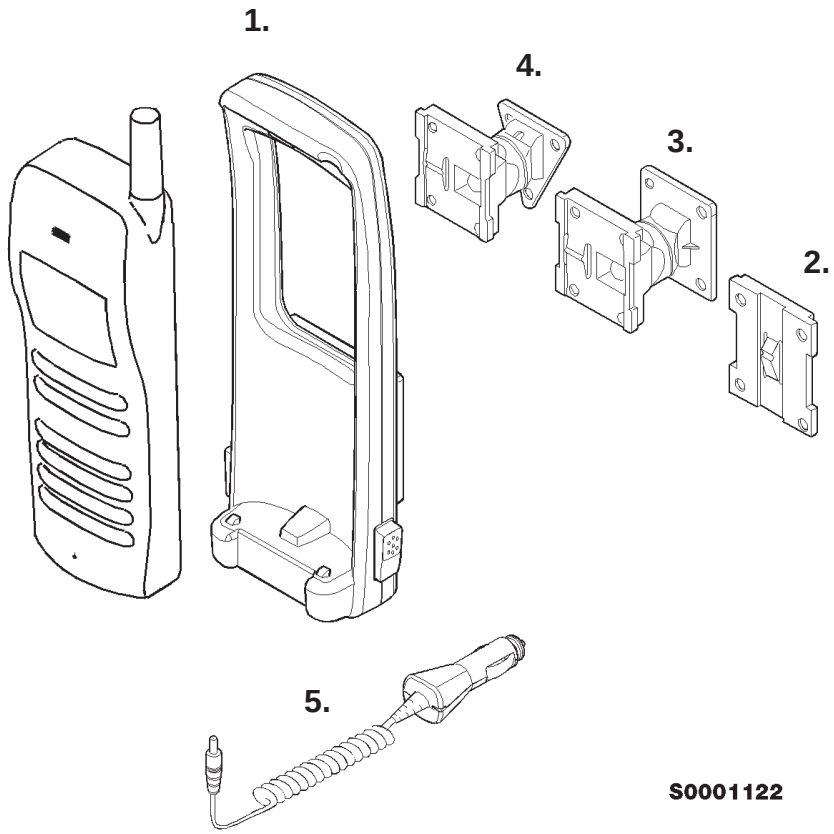
The desktop option allows the user to charge the handportable and spare battery from mains. With this option the user can also discharge the spare battery. The desktop option contains the following product:



Item/name:	Type:	Product code:
1. Basic stand	CGH–2	0700038
2. Desktop stand	CGH–1	0675078
3. Standard charger, trickle (UK plug)	ACH–8X	0675090
– Standard charger, trickle (Australia plug)	ACH–8A	
4. Standard charger, trickle (Euro plug)	ACH–8E	0675089
5. Fast & light charger, rapid (UK plug)	ACH–6X	0675087
– Fast & light charger, rapid (Australia plug)	ACH–6A	0675086
6. Fast & light charger, rapid (Euro plug)	ACH–6E	0675084

Basic Car Kit Option

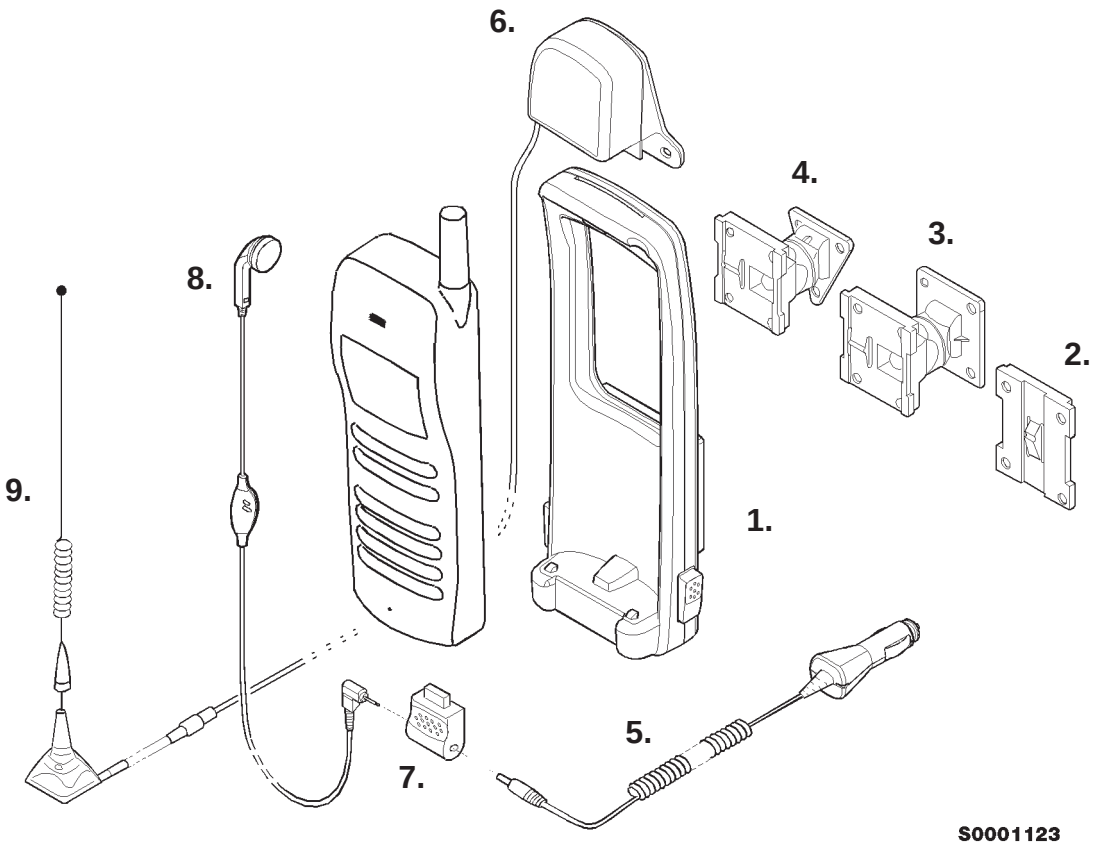
This option (Basic Car Kit) offers a passive cradle and charging functions to the user in the car installation. The light car kit option contains the following product:



Item/name:	Type:	Product code:
1. Phone holder	MBT–2	0620028
2. Mounting plate	MKE–7	0650007
3. Swivel mounting plate (square plate)	HHS–6	0650006
4. Swivel mounting plate (triangular plate)	HHS–7	
5. Universal mobile charger	LCH–6	0675076

Extended Car Kit Option

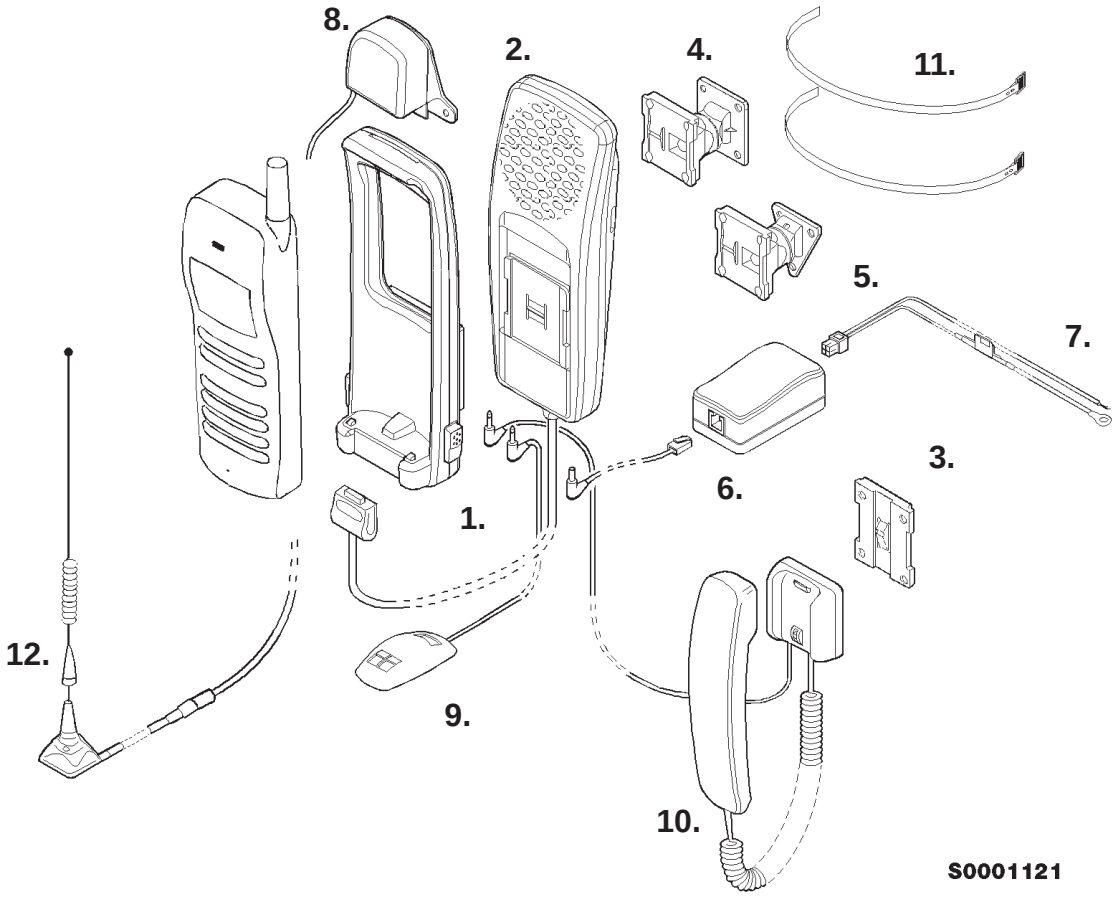
This option (Extended Car Kit Car Kit) offers a passive cradle and charging functions to the user in the car installation. The light car kit option contains the following product:



Item/name:	Type:	Product code:
1. Phone holder	MBT–2	0620028
2. Mounting plate	MKE–7	0650007
3. Swivel mounting plate (square plate)	HHS–6	0650006
4. Swivel mounting plate (triangular plate)	HHS–7	
5. Universal mobile charger	LCH–6	0675076
6. External antenna adapter	AAE–1	0750080
7. Headset adapter	HDA–4	06940??
8. Headset	HDC–2	0694017
9. External antenna (not supplied)		

Complete Car Kit Option

This option (Complete Car Kit) contains the same functions as the light car kit option and also offers full handsfree and external antenna functions. The use of the product can be extended for car use with the following accessories:



Item/name:	Type:	Product code:
1. Phone holder	MBT–2	0620028
2. Basic handsfree unit	PHF–5	0694028
3. Mounting plate	MKE–7	0650021
4. Swivel mounting plate (square plate)	HHS–6	0650019
5. Swivel mounting plate (triangular plate)	HHS–7	
6. Fixed mobile charger	LCM–1	0675077
7. Power cable	PCM–5	0730058
8. External antenna adapter	AAE–1	0750080
9. Handsfree microphone	HFM–7	0690012
10. Handset	HSU–2	0640078
11. Installation belts		
12. External antenna (not supplied)		
– Universal mobile charger (opt.)	LCH–6	0675076
– Headset (optional)	HDC–2	0694017

Product and Module List

Unit/type:	Product code:	Module code:
Transceiver NHE–5	See variant Appendixes	
Light Battery BBT–7S (450 mAh)	0670126	
Slim Battery BBT–3S (600 mAh)	0670125	
Extended Battery BBT–2S (950 mAh)	0670123	
Ultra Extended Battery BBT–2H (1200 mAh)	0670124	
Standard Charger ACH–8X (UK)	0675090	
Standard Charger ACH–8E (EUR)	0675089	
Standard Charger ACH–8A (AUS)		
Fast & Light Charger ACH–6X (UK)	0675087	
Fast & Light Charger ACH–6E (EUR)	0675084	
Fast & Light Charger ACH–6A (AUS)	0675086	
Universal Mobile Charger LCH–6	0675076	
Fixed Mobile Charger LCM–1	0675077	
Basic Stand CGH–2	0700038	
Desktop Stand CGH–1	0675078	
Phone Holder MBT–2	0620028	
Mounting Plate MKE–7	0650021	
Swivel Mounting Plate HHS–6	0650019	
Swivel Mounting Plate HHS–7	0650020	
Power Cable PCM–5	0730058	
Handset HSU–2	0640078	
Headset HDC–2	0694017	
Headset Adapter HDA–4	0694042	
Handsfree Microphone HFM–7	0690012	
External Antenna Adapter AAE–1	0750080	
Basic Handsfree Unit PHF–5	0694028	
• HF speaker module DH6		0200658
• Mechanics		0260677
Belt Clip BCH–6	0650023	

Technical Specifications

General Specifications of NHE–5 Series Transceiver

Temperature range	*+5° C to +40° C*
Operating time (with BBH–6S)	
• talk time	*? mins*
• standby time	*? hrs*
Battery voltage	*6 V*
Nominal current consumption	
• power off mode	*1.5 mA*
• idle mode	*9 mA*
• call mode,	*250...800 mA*
Dimensions (h x w x d)	
• transceiver + BBT–2S	*158 x 58 x 36 mm*
Weight	
• transceiver + BBT–7S/3S	*251 g*
• transceiver + BBT–2S	*288 g*
• transceiver + BBT–2H	*303 g*

Electrical Specifications

Transceiver General Features

Cellular system	*Global System for Mobile communications (GSM)*
Number of RF channels	*124*
Number of time domain channels	*81 RF channel*
Duplex spacing	*45 MHz*
Channel spacing	*200 kHz*
Modulation type	*GMSK*

Receiver Branch

Frequency band	*935.2...959.8 MHz*
Type	*linear, 2 IFs*
IF	*71 MHz and 13 MHz*
3 dB bandwith	*± 100 kHz*
Reference noise bandwidth	*270 kHz*
Sensitivity	*–102 dBm RX channel input* *I/Q S/N ratio > 8 dB*
AGC dynamic range	*93 dB, typ*
Receiver gain	*83 dB, typ*
RF front end gain control range	*36 dB*
2nd IF gain control range	*57 dB*
Input dynamic range	*–102...–10 dBm*
Gain relative accuracy in receiving band	*± 1.5 dB*
Gain relative accuracy on channel	*± 0.4 dB*

Transmitter Branch

Frequency band	*890.2...914.8 MHz*
Type	*Upconversion*
Intermediate frequency	*116 MHz*
Gain control range	*20 dB*
Power class	*4*
Output power	*13–33 dBm/20 mW...2 W*
Power levels	*11*
Power level step size	*2 dB ± 1.5 dB*
Tolerance at 2 W power	*< ± 2 dB (ext. temp. ± 2.5 dB)*
Tolerance at other levels	*± 3 dB (ext. temp. ± 4 dB)*
Frequency error	*± 0.1 ppm*
RMS phase error	*< 5°*
Peak phase error	*< 20°*

UHF Synthesizer

Receiver injection (LO1)	*1006.2...1030.8 MHz*
Settling time to any channel	*< 800 µs ± 20 Hz*

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Chapter 3

TRANSCEIVER OVERVIEW

Original 06/96

CHAPTER 2 – TRANSCEIVER OVERVIEW

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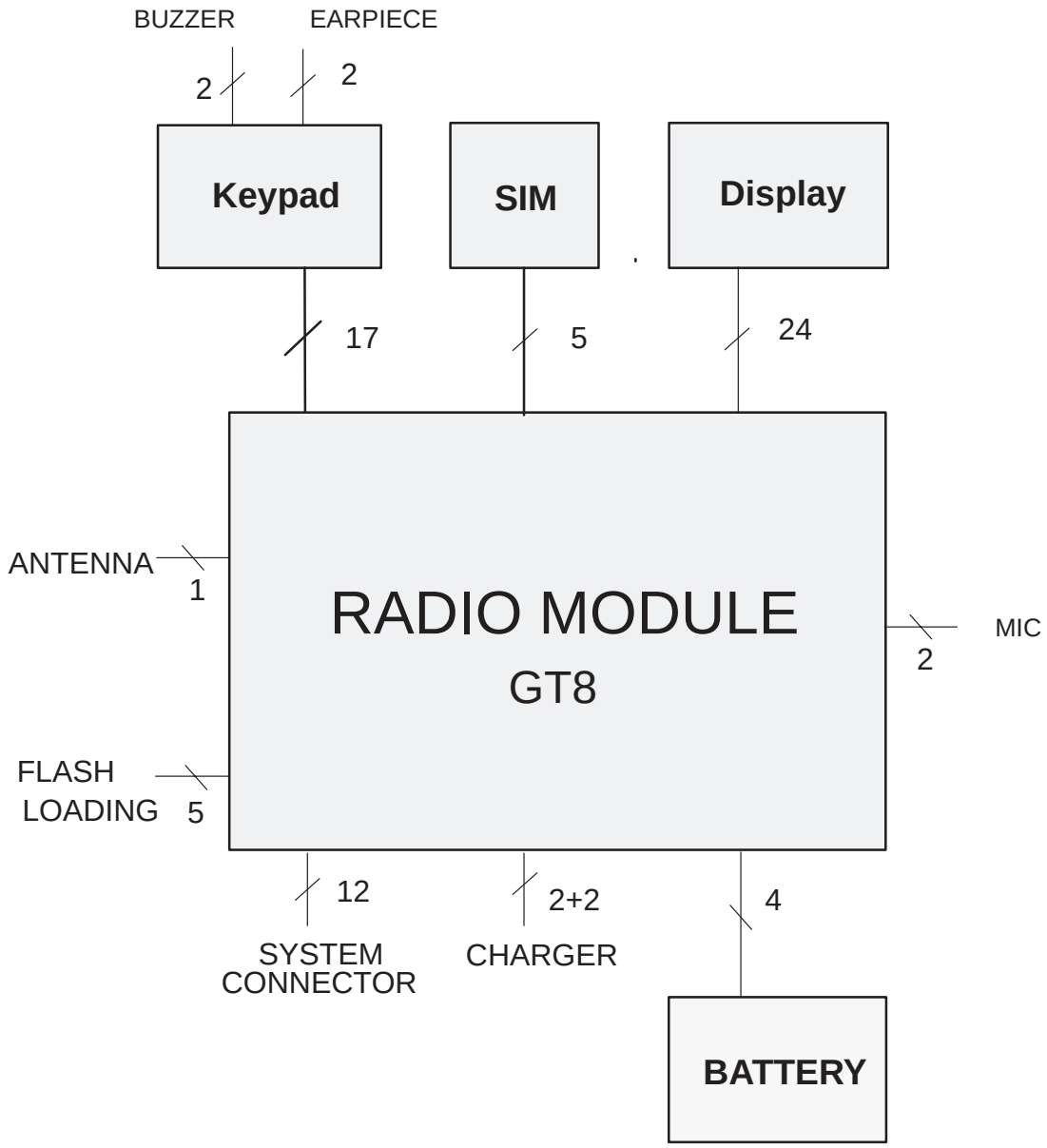
Introduction

The NHE–5 is a radio transceiver unit for the pan–European GSM network. It is a GSM phase 1 power class 4 transceiver providing 11 power levels with a maximum output power of 2 W.

The transceiver consists of a Radio module (GT8) and assembly parts

The full–size SIM (Subscriber Identity Module) card is located inside the phone.

Block Diagram of External Connections



Modes of Operation

There are five different operation modes

– power off mode
– idle mode
– active mode
– charge mode
– local mode

In the power off mode only the circuits needed for power up are supplied.

In the idle mode circuits are in reset, powered down and clocks are stopped as long as possible.

In the active mode all the circuits are supplied with power although some parts might be in the idle state part of the time.

The charge mode is in parallel of all previous modes. The charge mode itself consists of three different state: fast charge, discharge and tricle.

The local mode is used for alignment and testing.

Circuit Description

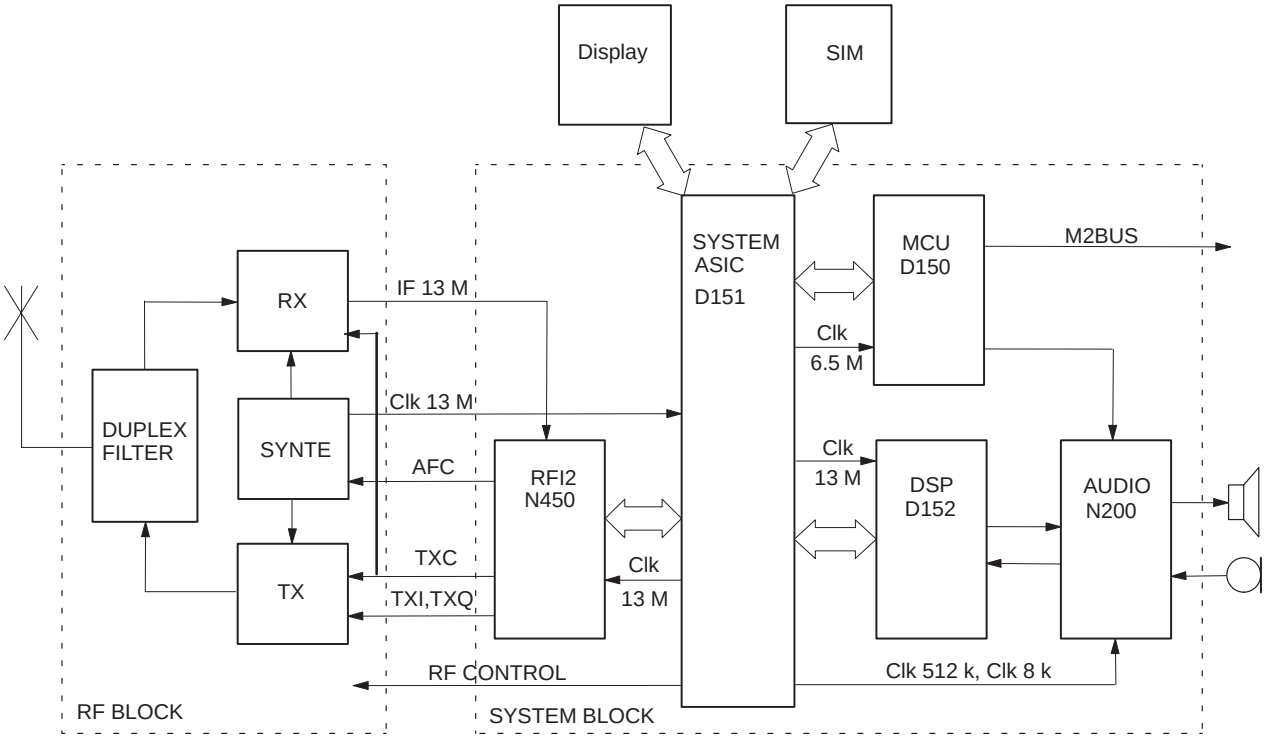
The transceiver electronics consist of the Radio Module (RF + System blocks), the UI PCB, the display module and audio components. The keypad and the display module are connected to the Radio Module with a connectors. System blocks and RF blocks are interconnected with PCB wiring. The Transceiver is connected to accessories via a bottom system connector with charging and accessory control.

The System blocks provide the MCU and DSP environments, Logic control IC, memories, audio processing and RF control hardware (RFI2). On board power supply circuitry (PSCLD) delivers operating voltages for both System and RF blocks.

The general purpose microcontroller, Hitachi H8, communicates with the DSP, memories and Logic control IC with an 8–bit data bus.

The RF block is designed for a handportable phone which operates in the GSM system. The purpose of the RF block is to receive and demodulate the radio frequency signal from the base station and to transmit a modulated RF signal to the base station.

Block Diagram



Power Distrubution Diagrams

The power supply is based on the ASIC circuit PSCLD. The chip consists of regulators and control circuits providing functions like power up, reset and watchdog functions. External buffering is required to provide more current.

The MCU and the PSCLD circuits control charging together, detection being carried out by the PSCLD and higher level intelligent control by the MCU. The MCU measures battery and charger voltages as well as the temperature and size of the battery via DSP by means of RFI2 internal ADC to sense the condition of the battery.

The detailed power distribution diagrams are given in Baseband blocks and RF blocks documents.

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After Sales Technical Documentation

NHE–5 TROUBLE–SHOOTING INSTRUCTIONS

Original 04/97

NMP Part No. 0275076

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

NHE–5 TROUBLESHOOTING INSTRUCTIONS

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Audio Fault Page 17

Introduction

General

The purpose is to define fault block of the module and then find out the broken component. The trouble shooting diagram has been planned so that the fault, whatever it is, can be found by as simple measurements as possible.

The flow diagrams give you the overview of the blocks. The purpose is that you proceed through the flow diagram so that, if your answer is YES for the asked question, go straight to the next level, but if your answer is NO, you have to go the subbranch.

Required servicing equipment:

- PC for Service Software
- Power supply (2.0 A)
- Digital multimeter
- Oscilloscope
- Spectrum analyzer
- Signal generator
- RF cables
- Modular cable
- RS232/MBUS adapter
- HP8922H or equal
- RF measuring chassis

The Troubleshooting for NHE–5 consist of a series of checks according to the following flow diagrams.

Baseband Troubleshooting

The following hints should facility finding the cause of the problem when the circuitry seems to be faulty. This troubleshooting instruction is divided following section.

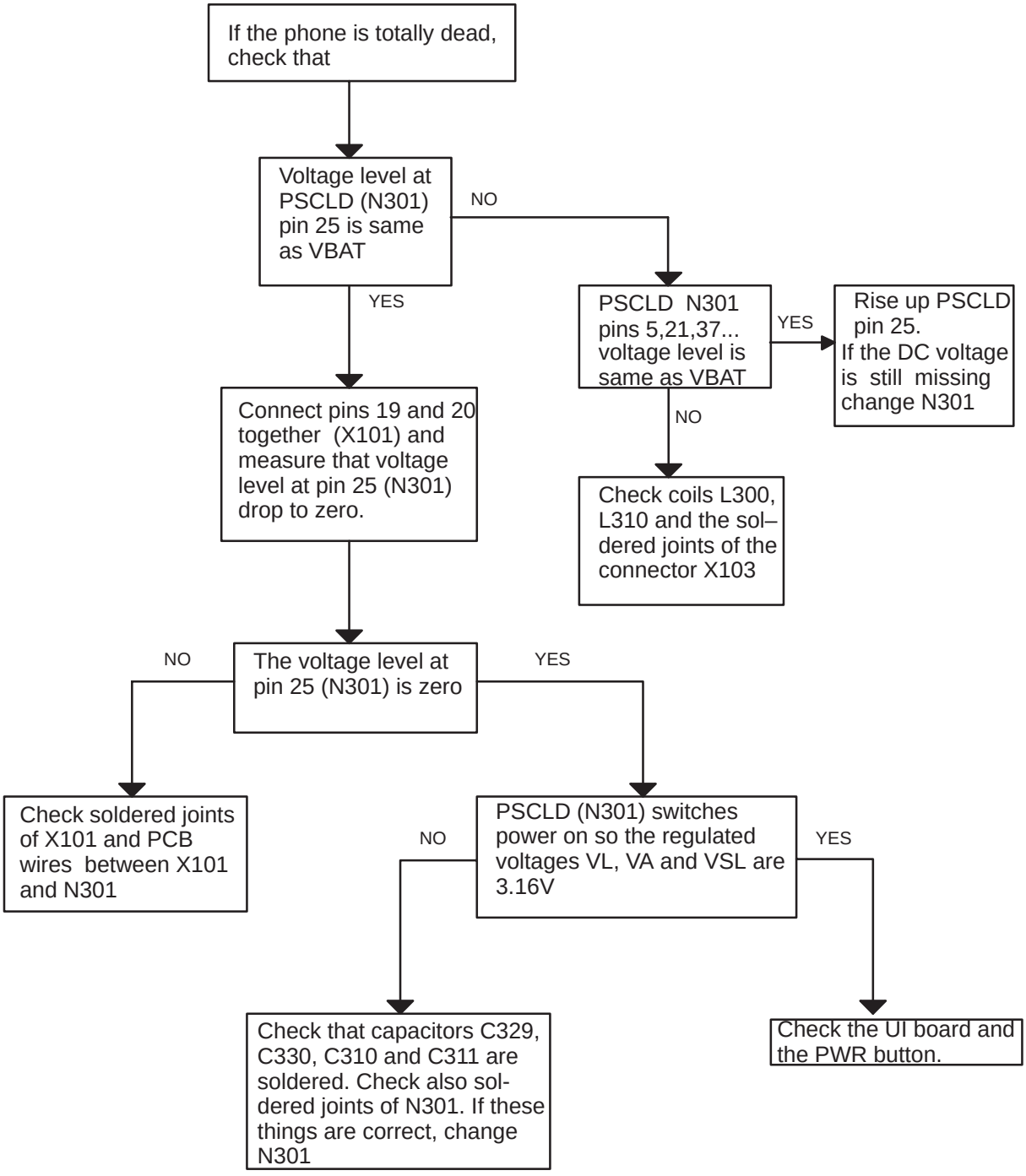
1. Phone is totally dead
2. Flash programming doesn‘t work
3. Power doesn‘t stay on or the phone is jammed
4. Display information: Contact Service
5. Phone doesn‘t register to the network or phone doesn‘t make a call.
6. Plug in SIM card is out of order (insert SIM card or card rejected).
7. Audio fault.

The first thing to do is carry out a through visual check of the module. Ensure in particular that:

a) there are not any mechanical damages
b) soldered joints are OK

Phone is Totally Dead

Troubleshooting diagram for this fault is represented in following figure. Check at first that the battery back is OK and it is not empty. This kind of fault has been limited around the system connector (X103) and the PSCLD (N301).


If the phone is totally dead, check that
Voltage level at PSCLD (N301) pin 25 is same as VBAT
NO
YES
PSCLD N301 pins 5,21,37... voltage level is same as VBAT
YES
Rise up PSCLD pin 25. If the DC voltage is still missing change N301
NO
Check coils L300, L310 and the sol–dered joints of the connector X103
Connect pins 19 and 20 together (X101) and measure that voltage level at pin 25 (N301) drop to zero.
NO
The voltage level at pin 25 (N301) is zero
YES
Check soldered joints of X101 and PCB wires between X101 and N301
NO
PSCLD (N301) switches power on so the regulated voltages VL, VA and VSL are 3.16V
YES
Check that capacitors C329, C330, C310 and C311 are soldered. Check also sol-dered joints of N301. If these things are correct, change N301
Check the UI board and the PWR button.

Flash Programming Doesn‘t Work

The block diagram for the flash programming is shown in figure 12. The flash loading is handled via these components. Thus a fault in other components (DSP, RFI) can not prevent the flash loading.

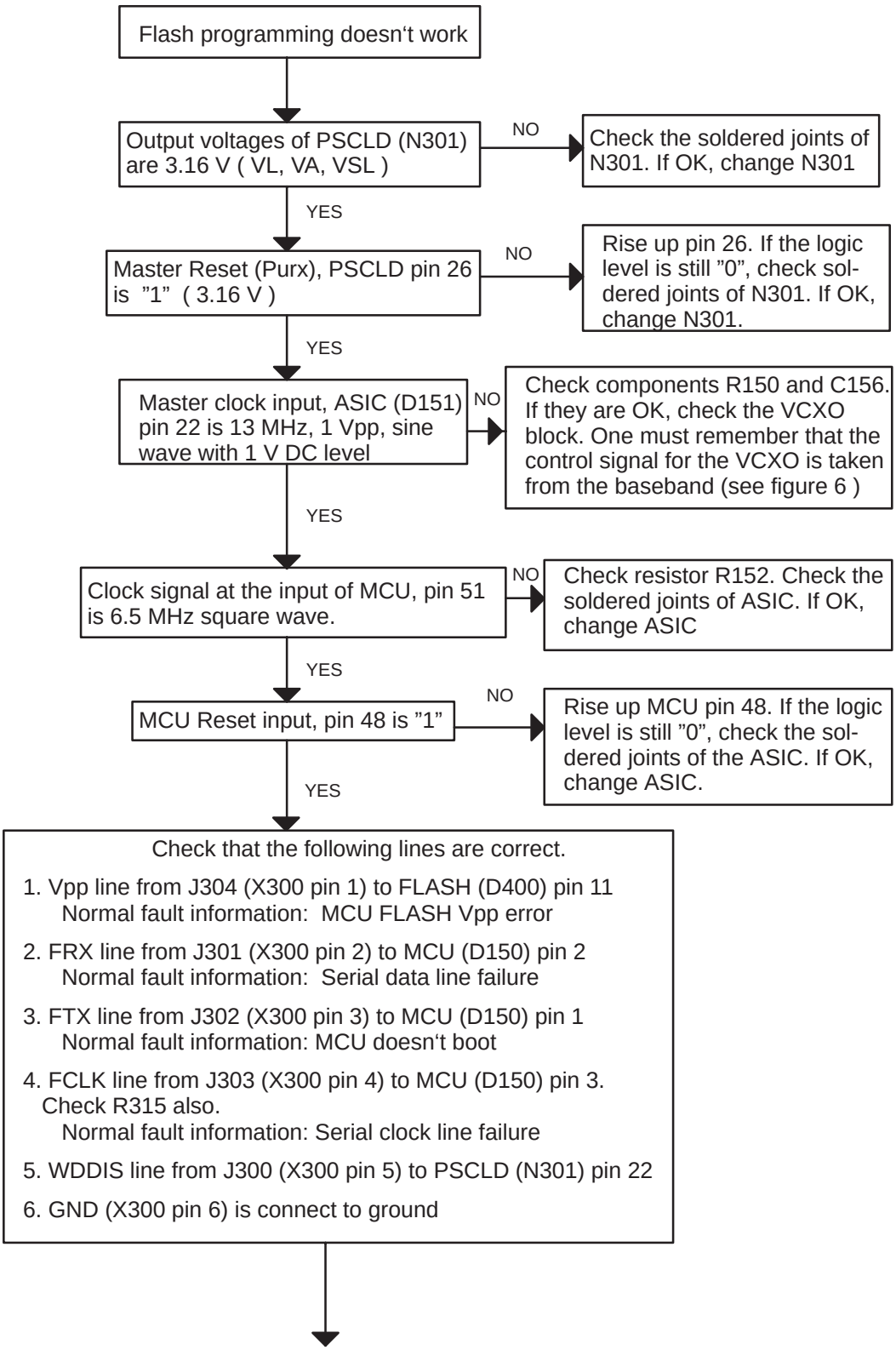
In error cases, the flash prommer can give some information about a fault. The fault information messages could be:
– MCU doesn‘t boot
– MCU flash Vpp error
– Serial data line failure
– Serial clock line failure
– External RAM fault
– Algorithm file or alias ID don‘t find

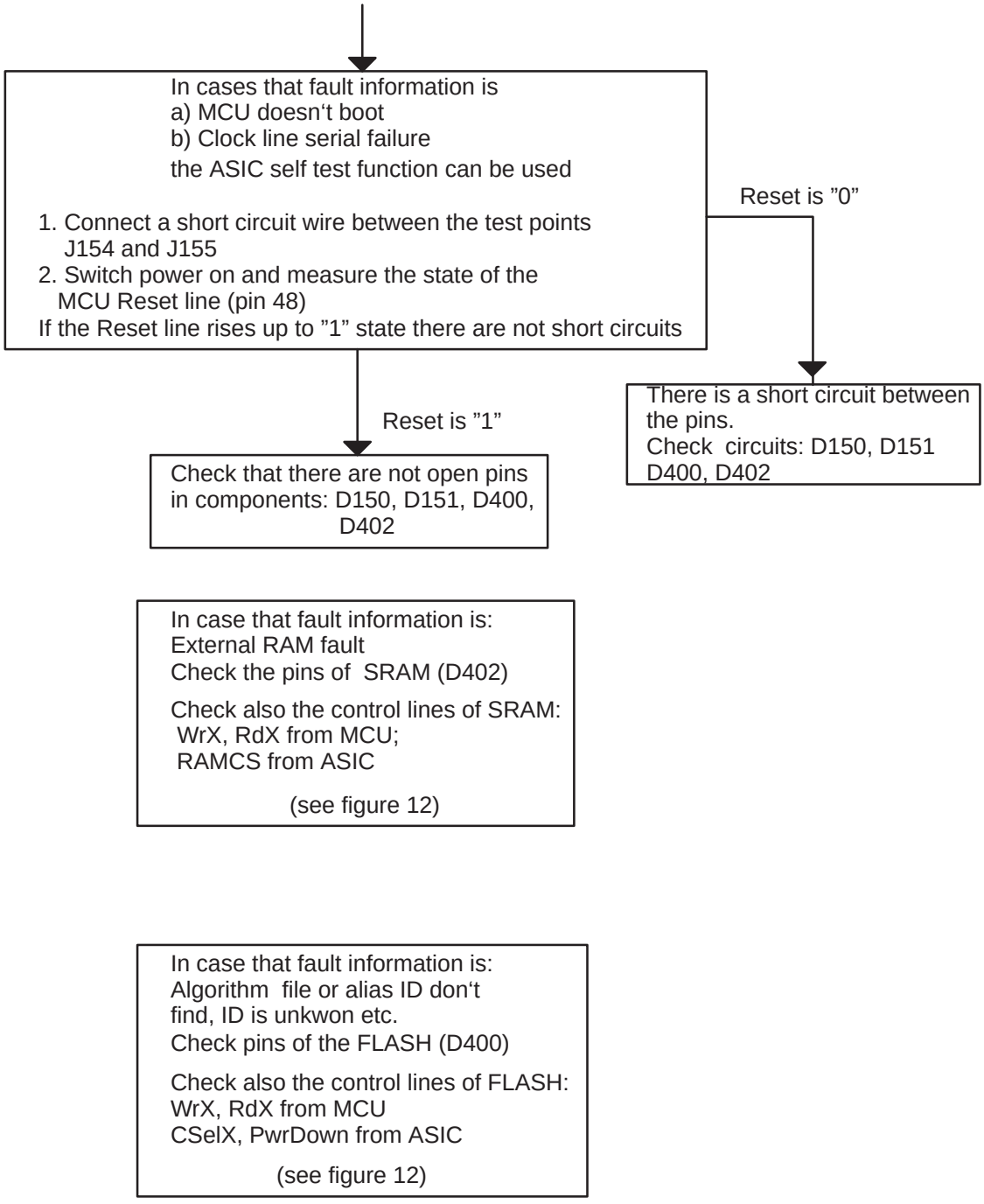
In cases that the the flash programming doesn‘t succeed, there is a possibility to test the interface between the ASIC and the MCU.
This test is useful to do, when the fault information is: MCU doesn‘t boot or Serial clock line failure.

The test procedure is following:

1. Connect a short circuit wire between the test points J154 and J155.
2. Switch power on.
3. If the reset line of the MCU rises up, the interface is OK. Otherwise the reset line stays low.

One must be noticed that this test can be found only short circuits, not open pins. This test indicate also that 32 kHz clock is running because of the test logic is made by using 32 kHz clock oscillator.


Flash programming doesn‘t work
Output voltages of PSCLD (N301) are 3.16 V (VL, VA, VSL)
NO
Check the soldered joints of N301. If OK, change N301
YES
Master Reset (Purx), PSCLD pin 26 is ”1” (3.16 V)
NO
Rise up pin 26. If the logic level is still ”0”, check soldered joints of N301. If OK, change N301.
YES
Master clock input, ASIC (D151) pin 22 is 13 MHz, 1 Vpp, sine wave with 1 V DC level
NO
Check components R150 and C156. If they are OK, check the VCXO block. One must remember that the control signal for the VCXO is taken from the baseband (see figure 6)
YES
Clock signal at the input of MCU, pin 51 is 6.5 MHz square wave.
NO
Check resistor R152. Check the soldered joints of ASIC. If OK, change ASIC
YES
MCU Reset input, pin 48 is ”1”
NO
Rise up MCU pin 48. If the logic level is still ”0”, check the soldered joints of the ASIC. If OK, change ASIC.
YES
Check that the following lines are correct.
1. Vpp line from J304 (X300 pin 1) to FLASH (D400) pin 11
Normal fault information: MCU FLASH Vpp error
2. FRX line from J301 (X300 pin 2) to MCU (D150) pin 2
Normal fault information: Serial data line failure
3. FTX line from J302 (X300 pin 3) to MCU (D150) pin 1
Normal fault information: MCU doesn‘t boot
4. FCLK line from J303 (X300 pin 4) to MCU (D150) pin 3. Check R315 also.
Normal fault information: Serial clock line failure
5. WDDIS line from J300 (X300 pin 5) to PSCLD (N301) pin 22
6. GND (X300 pin 6) is connect to ground


In cases that fault information is
a) MCU doesn‘t boot
b) Clock line serial failure
the ASIC self test function can be used
1. Connect a short circuit wire between the test points J154 and J155
2. Switch power on and measure the state of the MCU Reset line (pin 48)
If the Reset line rises up to ”1” state there are not short circuits
Reset is ”0”
There is a short circuit between the pins.
Check circuits: D150, D151 D400, D402
Reset is ”1”
Check that there are not open pins in components: D150, D151, D400, D402
In case that fault information is:
External RAM fault
Check the pins of SRAM (D402)
Check also the control lines of SRAM:
WrX, RdX from MCU;
RAMCS from ASIC
(see figure 12)
In case that fault information is:
Algorithm file or alias ID don‘t find, ID is unkwon etc.
Check pins of the FLASH (D400)
Check also the control lines of FLASH:
WrX, RdX from MCU
CSelX, PwrDown from ASIC
(see figure 12)

Power Doesn‘t Stay On or The Phone is Jammed

If a fault has come after the flash programming, there are most probably open pins in IC‘s.
The soldered joints of IC’s: D150 (MCU), D151 (ASIC), N301(PSCLD), D400 (FLASH), D402 (SRAM) is useful to check at first.

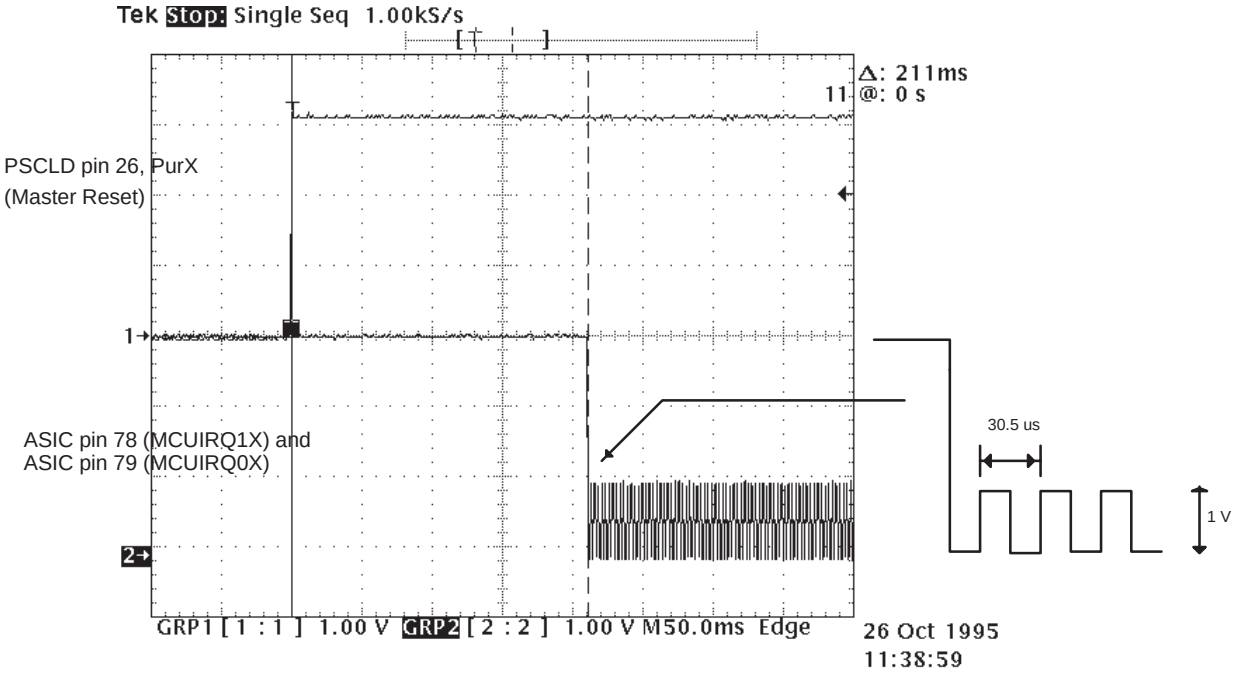
Normally, the power switch off after 30 seconds, if the watchdog of the PSCLD can not be served by software. The power off function can be prevented by connecting a short circuit wire from the PSCLD pin 22 (WDDIS) to the ground.

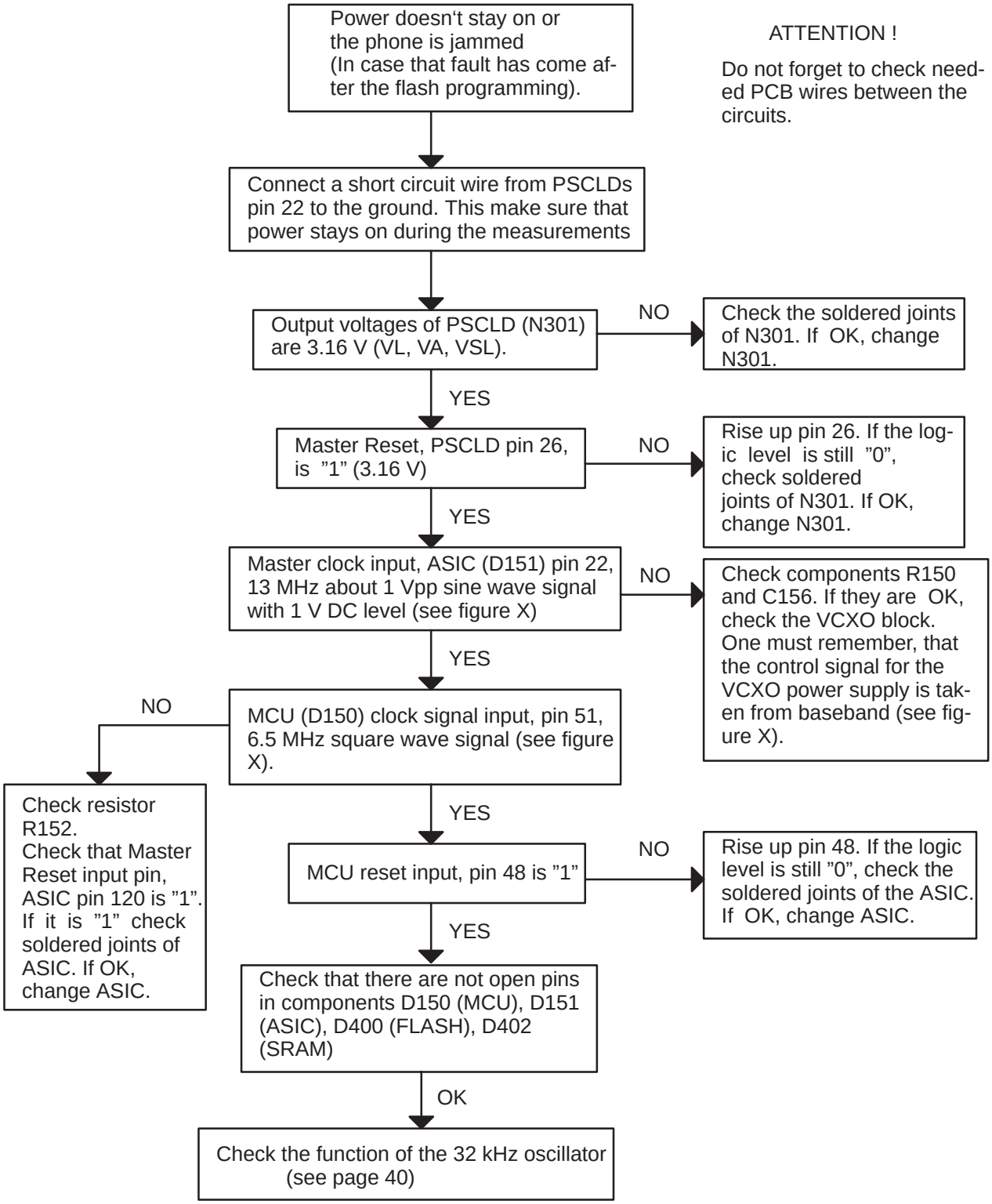
If the power switches off after 1..2 seconds, the pins of PSCLD and the PSCLD‘s auxiliary components must be checked.

If the phone is jammed, and no other reason has been found, the function of 32 kHz clock oscillator must be checked. This can be done by setting the phone to the ASIC self test mode.

1. Connect a short circuit wire between the test points J154 and J155.
2. Make a short circuit between the ASIC pins 78 and 79.
3. Switch power on.
4. Measure the signal by oscilloscope at pins 78, 79 (ASIC).

The Function of the 32 kHz Clock Oscillator in Test Circumstances

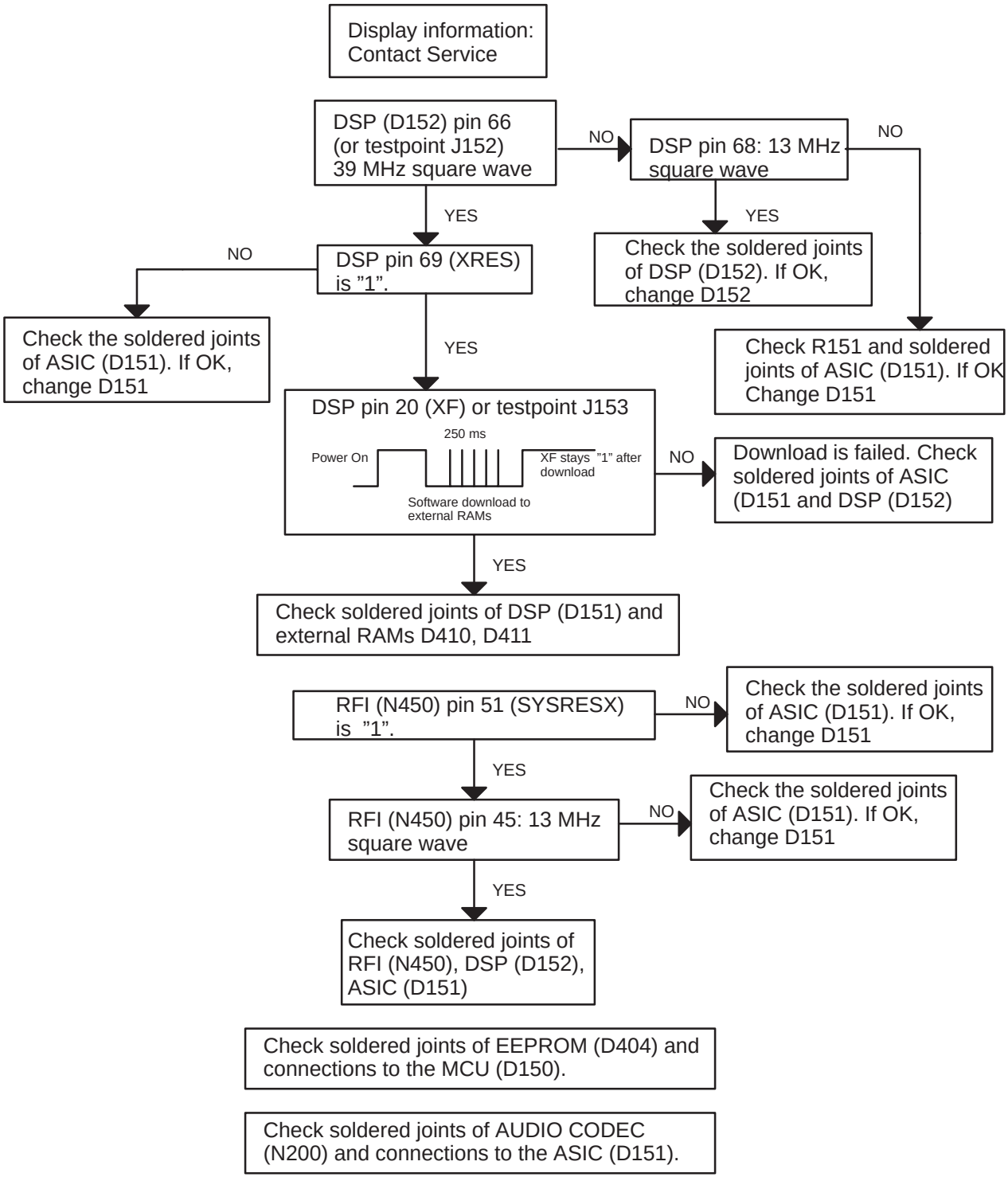

Tek Stop: Single Seq 1.00kS/s
Δ: 211ms
@: 0 s
PSCLD pin 26, PurX
(Master Reset)
ASIC pin 78 (MCUIRQ1X) and
ASIC pin 79 (MCUIRQ0X)
30.5 us
1 V
GRP1 [1 : 1] 1.00 V GRP2 [2 : 2] 1.00 V M50.0ms Edge
26 Oct 1995
11:38:59


Power doesn‘t stay on or the phone is jammed (In case that fault has come after the flash programming).
ATTENTION !
Do not forget to check needed PCB wires between the circuits.
Connect a short circuit wire from PSCLDs pin 22 to the ground. This make sure that power stays on during the measurements
Output voltages of PSCLD (N301) are 3.16 V (VL, VA, VSL).
NO
Check the soldered joints of N301. If OK, change N301.
YES
Master Reset, PSCLD pin 26, is ”1” (3.16 V)
NO
Rise up pin 26. If the logic level is still ”0”, check soldered joints of N301. If OK, change N301.
YES
Master clock input, ASIC (D151) pin 22, 13 MHz about 1 Vpp sine wave signal with 1 V DC level (see figure X)
NO
Check components R150 and C156. If they are OK, check the VCXO block. One must remember, that the control signal for the VCXO power supply is taken from baseband (see figure X).
YES
NO
MCU (D150) clock signal input, pin 51, 6.5 MHz square wave signal (see figure X).
Check resistor R152. Check that Master Reset input pin, ASIC pin 120 is ”1”. If it is ”1” check soldered joints of ASIC. If OK, change ASIC.
YES
MCU reset input, pin 48 is ”1”
NO
Rise up pin 48. If the logic level is still ”0”, check the soldered joints of the ASIC. If OK, change ASIC.
YES
Check that there are not open pins in components D150 (MCU), D151 (ASIC), D400 (FLASH), D402 (SRAM)
OK
Check the function of the 32 kHz oscillator (see page 40)

Display Information: Contact Service

This fault means that MCU is able to run and the watchdog of the PSCLD (N301) can be served. Thus PCLocals functions can be used and some information about the fault is possible to get.

In principle, the fault for contact service information can be found around ASIC (D151), DSP (D152), RFI (N450), EEPROM (D404) or AUDIO CODEC (N200).


Display information: Contact Service
DSP (D152) pin 66 (or testpoint J152) 39 MHz square wave
NO
DSP pin 68: 13 MHz square wave
NO
YES
YES
NO
DSP pin 69 (XRES) is ”1”.
Check the soldered joints of DSP (D152). If OK, change D152
Check the soldered joints of ASIC (D151). If OK, change D151
YES
Check R151 and soldered joints of ASIC (D151). If OK Change D151
DSP pin 20 (XF) or testpoint J153
250 ms
Power On
XF stays ”1” after download
Software download to external RAMs
NO
Download is failed. Check soldered joints of ASIC (D151 and DSP (D152)
YES
Check soldered joints of DSP (D151) and external RAMs D410, D411
RFI (N450) pin 51 (SYSRESX) is ”1”.
NO
Check the soldered joints of ASIC (D151). If OK, change D151
YES
RFI (N450) pin 45: 13 MHz square wave
NO
Check the soldered joints of ASIC (D151). If OK, change D151
YES
Check soldered joints of RFI (N450), DSP (D152), ASIC (D151)
Check soldered joints of EEPROM (D404) and connections to the MCU (D150).
Check soldered joints of AUDIO CODEC (N200) and connections to the ASIC (D151).

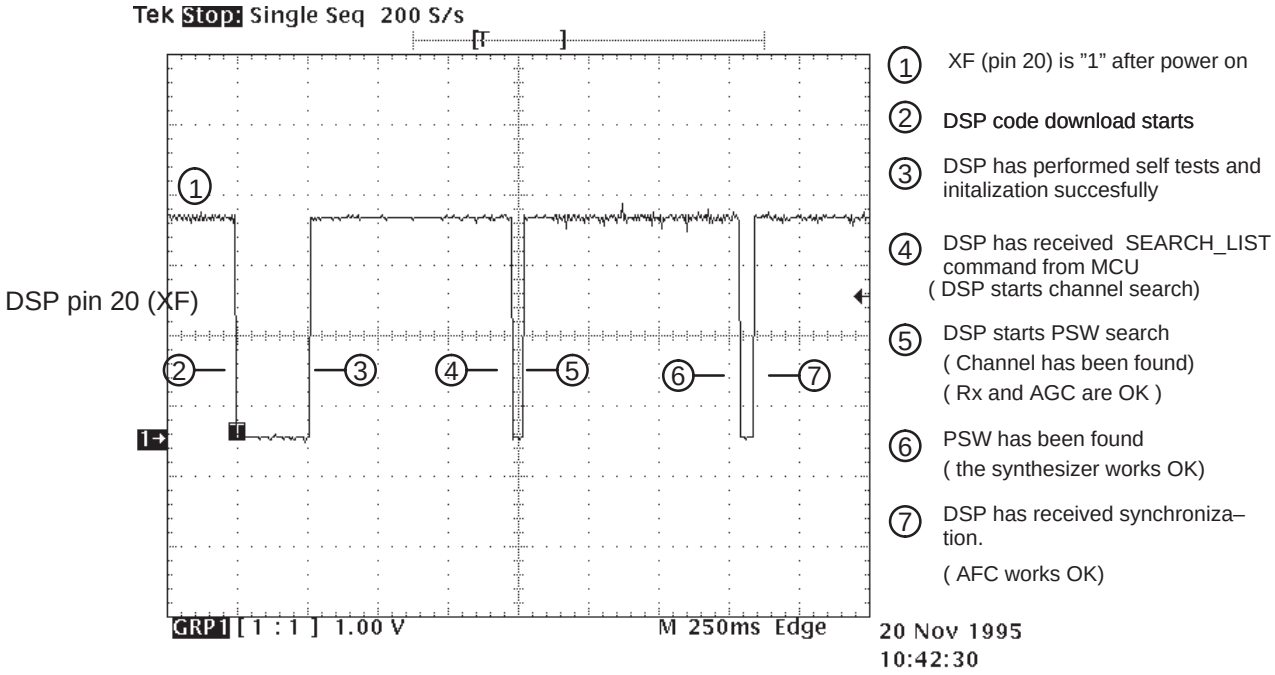
The Phone Doesn‘t Register to The Network (no serv) or Phone Doesn‘t Make a Call

If the phone doesn‘t register to the network or the phone doesn‘t make a call, the reason for this could be either the baseband or the RF part. The phone can be set to wanted mode by PCLocals software and try to find reason for fault.

The control lines for RF are supplied both the ASIC (D151) and the RFI (N450). The ASIC handles digital control lines (between ”0” = 0 V and ”1” = 3.16 V) and the RFI handles analog control lines and proper input and output signals.

The DSP uses its external flag outpin (XF pin 20) as an indicator of its operation state. During power up, DSP signals all completed functions by changing the state of the XF pin (see figure 38).

The States of The DSP after Power On


Tek Stop: Single Seq 200 S/s
DSP pin 20 (XF)
1
2
3
4
5
6
7
GRP1 [1 : 1] 1.00 V
M 250ms Edge
20 Nov 1995
10:42:30
1 XF (pin 20) is ”1” after power on
2 DSP code download starts
3 DSP has performed self tests and initalization succesfully
4 DSP has received SEARCH_LIST command from MCU
(DSP starts channel search)
5 DSP starts PSW search
(Channel has been found)
(Rx and AGC are OK)
6 PSW has been found
(the synthesizer works OK)
7 DSP has received synchroniza–tion.
(AFC works OK)

Phone doesn‘t register to the network or phone doesn‘t make a call

RFI (N450) pins 9,10,11 DC level 4.5 V

NO

Check transistor V450. Check RF regu–lator N601. One must remember, that control signal for RF regulator N601 (pins 12 and 16) is taken from ASIC (D151) pin 130 and routed to the RF via PSCLD (N301) pins 17, 13.

YES

RFI (N450) pin 3 (REFOUT) DC level 2.5 V

NO

Check components C452 and C453. If OK, Change RFI (N450)

YES

ASIC pin 33 (RxPwr) is ”1” during the receive slot
ASIC pin 34 (SynthPwr) is ”1” during the receive slot
ASIC pin 35 (SEna1X) is ”0” during the receive slot
ASIC pin 39 (SCLK) is ”1” during the receive slot
ASIC pin 38 (SDATA) is ”1” during the receive slot

Check the soldered joints of ASIC (D151) and the connections to the RF part

GT8 YES GT7

RFI pin 16 (TXCOUT) is ”1” during the receive slot
RFI pin 24 (PDATA0) is ”1” during the receive slot
RFI pin 24 (PDATA0) is ”1” during the receive slot
RFI pin 54 (RXINN): DC level 1.6 V during rec. slot
RFI pin 55 (RXINP): DC level 1.6 V during rec. slot
RFI pin 64 (AFC) : 1 V < DC level < 3 V

YES

RFI pin 16 (TXCOUT) is ”1” during the receive slot
RFI pin 52 (RefRX): DC level 1.6 V
RFI pin 53 (RXIAux) DC level 1.6 V during rec. slot
RFI pin 55 (RXINP): DC level 1.6 V during rec. slot
RFI pin 64 (AFC) : 1 V < DC level < 3 V

NO

Check the soldered joints of RFI (N450) and the con-nections to the RF part

Use service Software functions to turn transmitter on

NO

Check the soldered joints of RFI (N450) and the con-nections to the RF part

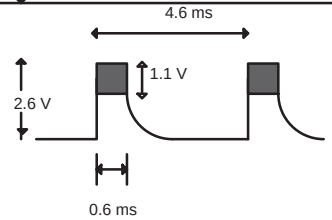
ASIC pin 31 (TXP) is ”1” during the transmit slot
ASIC pin 32 (TXPWR) is ”1” during the transmit slot

NO

Check the soldered joints of ASIC(D151) and the connections to the RF part

YES

RFI pin 1 (TXQN)
RFI pin 2 (TXQP)
RFI pin 12 (TXIN)
RFI pin 13 (TXIP)



YES

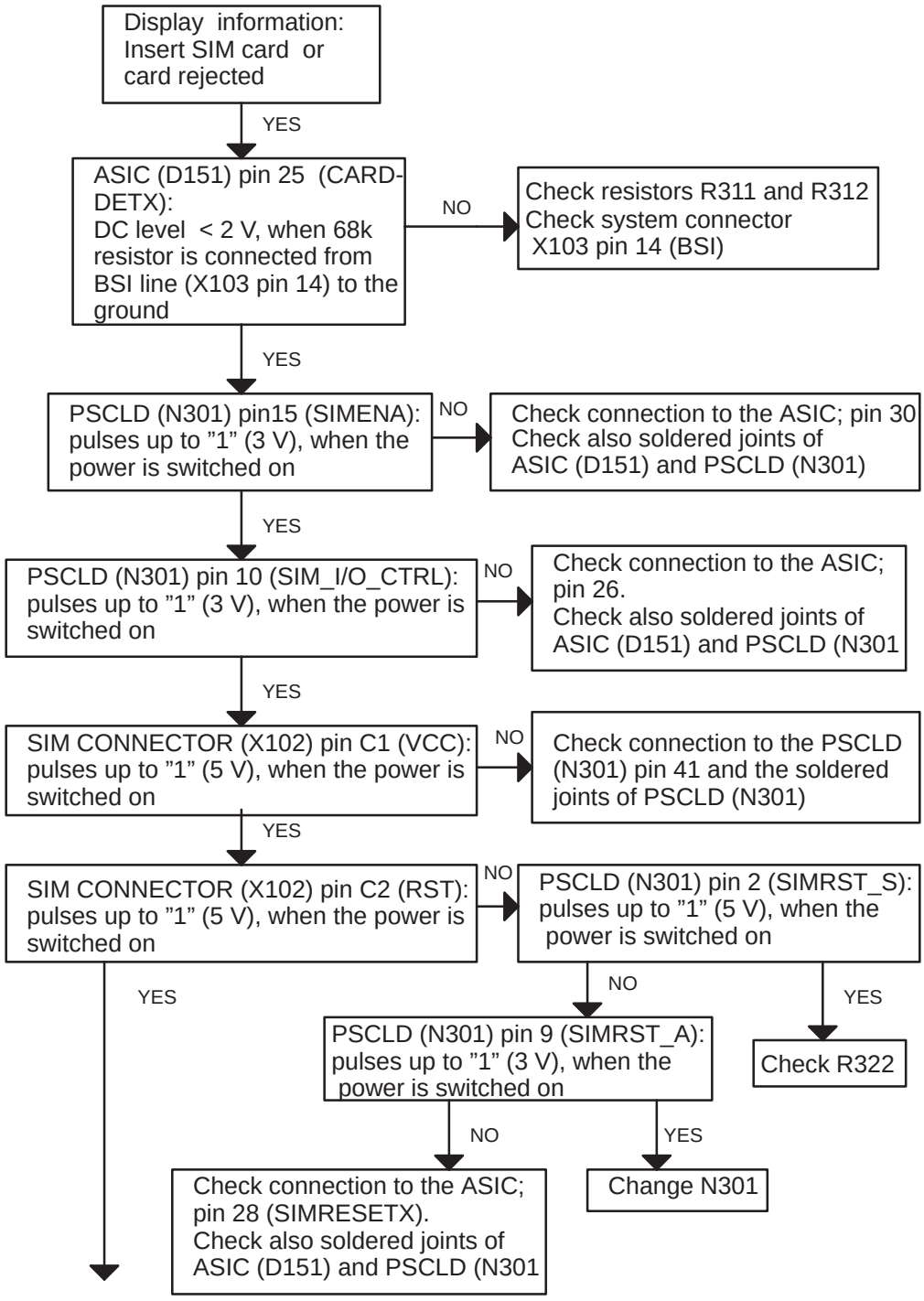
NO

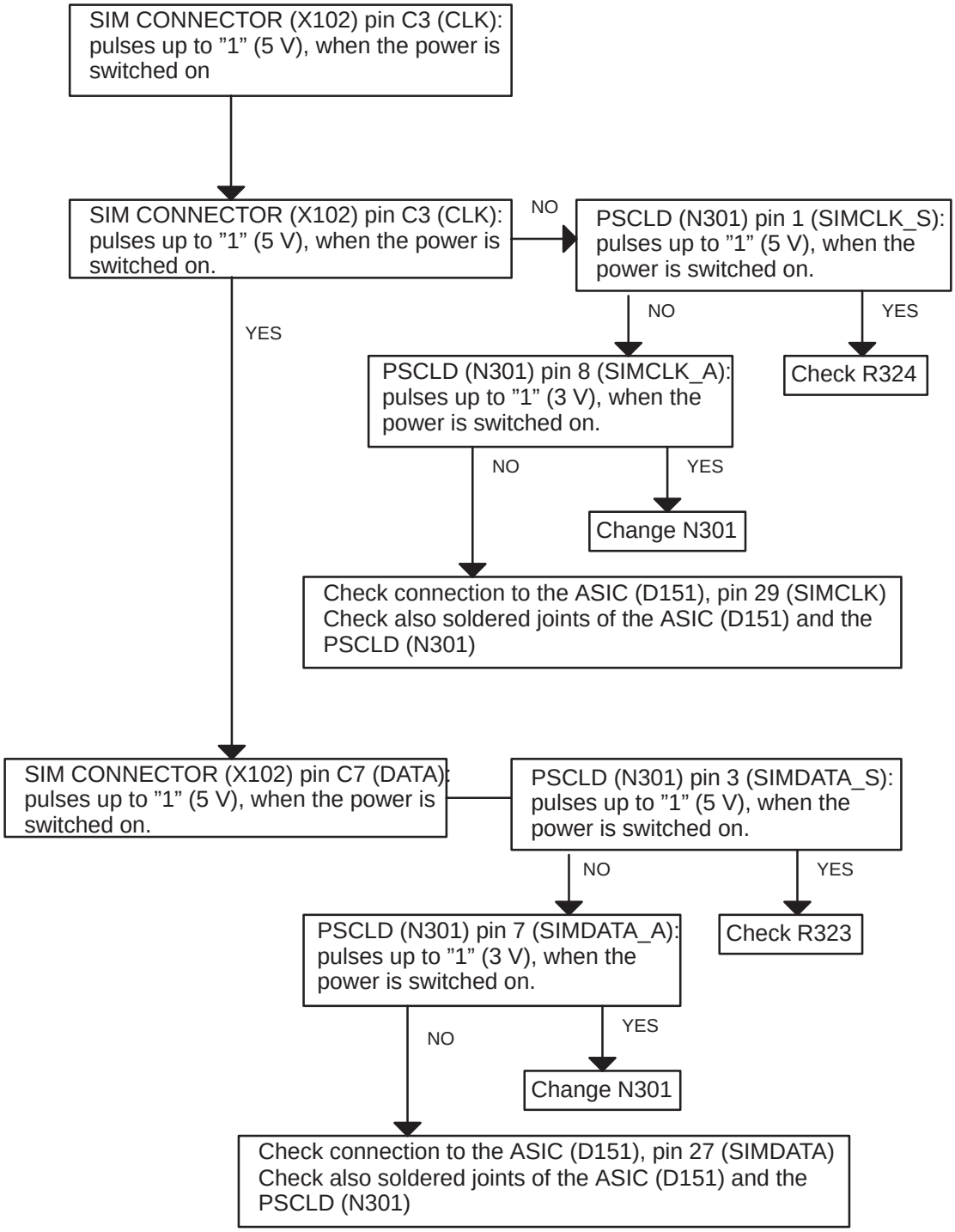
Check the soldered joints of RFI (N450) and the con-nections to the RF part

CHECK RF PART

SIM Card is Out of Order (Insert SIM Card or Card Rejected)

The hardware of the SIM interface from the ASIC (D151) to the SIM connector (X102) can be tested without SIM card. When the power is switched on and if the BSI line is grounded by resistor, all the used lines (VSIM, RST, CLK, DATA) rises up to ”1” (5 V) four times. Thus the fault can be found without SIM card most of the cases.


Display information: Insert SIM card or card rejected
YES
ASIC (D151) pin 25 (CARD-DETX): DC level < 2 V, when 68k resistor is connected from BSI line (X103 pin 14) to the ground
NO
Check resistors R311 and R312 Check system connector X103 pin 14 (BSI)
YES
PSCLD (N301) pin15 (SIMENA): pulses up to ”1” (3 V), when the power is switched on
NO
Check connection to the ASIC; pin 30 Check also soldered joints of ASIC (D151) and PSCLD (N301)
YES
PSCLD (N301) pin 10 (SIM_I/O_CTRL): pulses up to ”1” (3 V), when the power is switched on
NO
Check connection to the ASIC; pin 26. Check also soldered joints of ASIC (D151) and PSCLD (N301
YES
SIM CONNECTOR (X102) pin C1 (VCC): pulses up to ”1” (5 V), when the power is switched on
NO
Check connection to the PSCLD (N301) pin 41 and the soldered joints of PSCLD (N301)
YES
SIM CONNECTOR (X102) pin C2 (RST): pulses up to ”1” (5 V), when the power is switched on
NO
PSCLD (N301) pin 2 (SIMRST_S): pulses up to ”1” (5 V), when the power is switched on
YES
NO
YES
PSCLD (N301) pin 9 (SIMRST_A): pulses up to ”1” (3 V), when the power is switched on
Check R322
NO
YES
Check connection to the ASIC; pin 28 (SIMRESETX). Check also soldered joints of ASIC (D151) and PSCLD (N301
Change N301

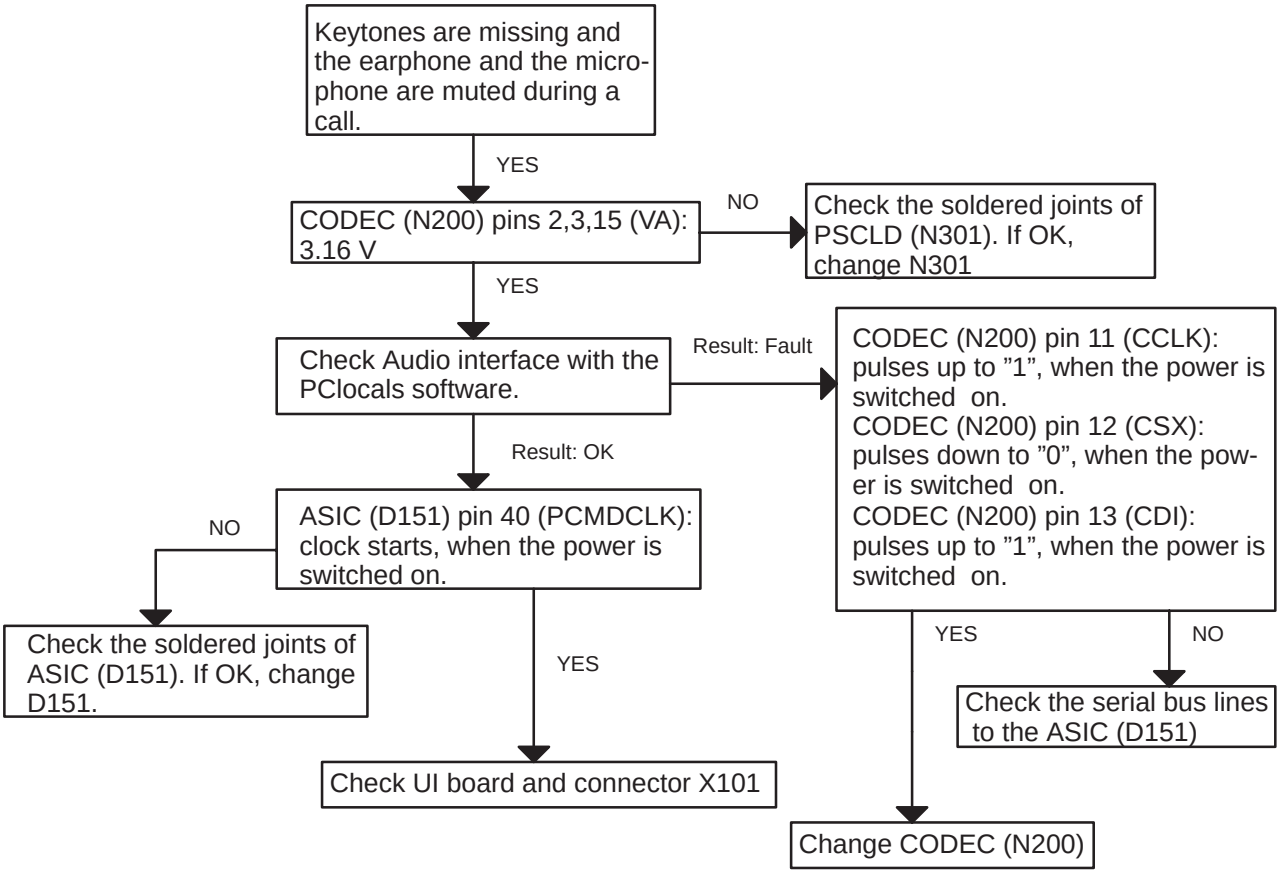

SIM CONNECTOR (X102) pin C3 (CLK): pulses up to ”1” (5 V), when the power is switched on
SIM CONNECTOR (X102) pin C3 (CLK): pulses up to ”1” (5 V), when the power is switched on.
NO
PSCLD (N301) pin 1 (SIMCLK_S): pulses up to ”1” (5 V), when the power is switched on.
YES
NO
YES
Check R324
PSCLD (N301) pin 8 (SIMCLK_A): pulses up to ”1” (3 V), when the power is switched on.
NO
YES
Change N301
Check connection to the ASIC (D151), pin 29 (SIMCLK) Check also soldered joints of the ASIC (D151) and the PSCLD (N301)
SIM CONNECTOR (X102) pin C7 (DATA): pulses up to ”1” (5 V), when the power is switched on.
PSCLD (N301) pin 3 (SIMDATA_S): pulses up to ”1” (5 V), when the power is switched on.
NO
YES
Check R323
PSCLD (N301) pin 7 (SIMDATA_A): pulses up to ”1” (3 V), when the power is switched on.
NO
YES
Change N301
Check connection to the ASIC (D151), pin 27 (SIMDATA) Check also soldered joints of the ASIC (D151) and the PSCLD (N301)

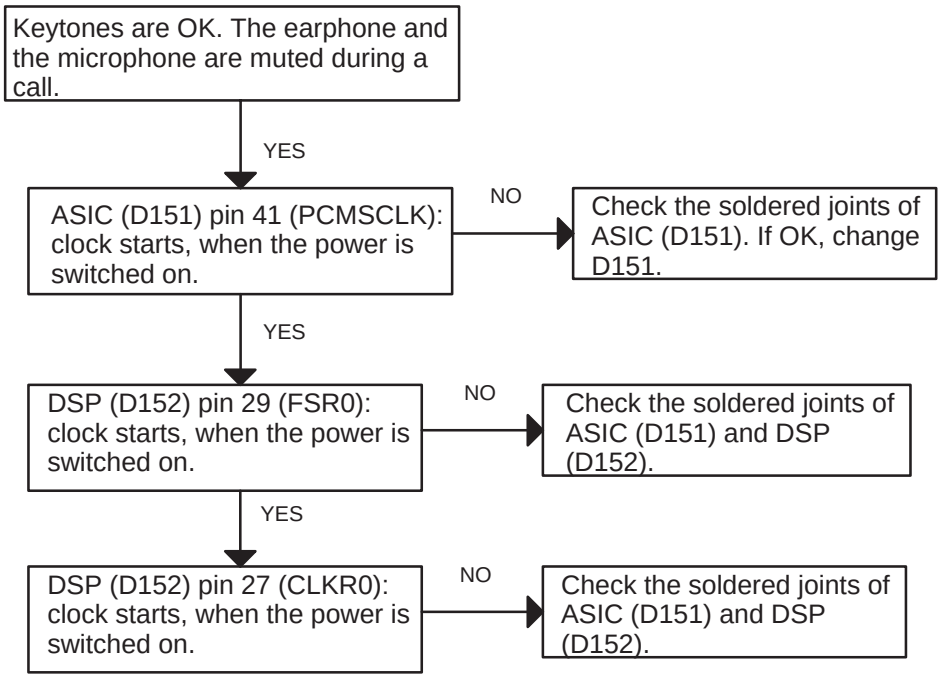
Audio Fault

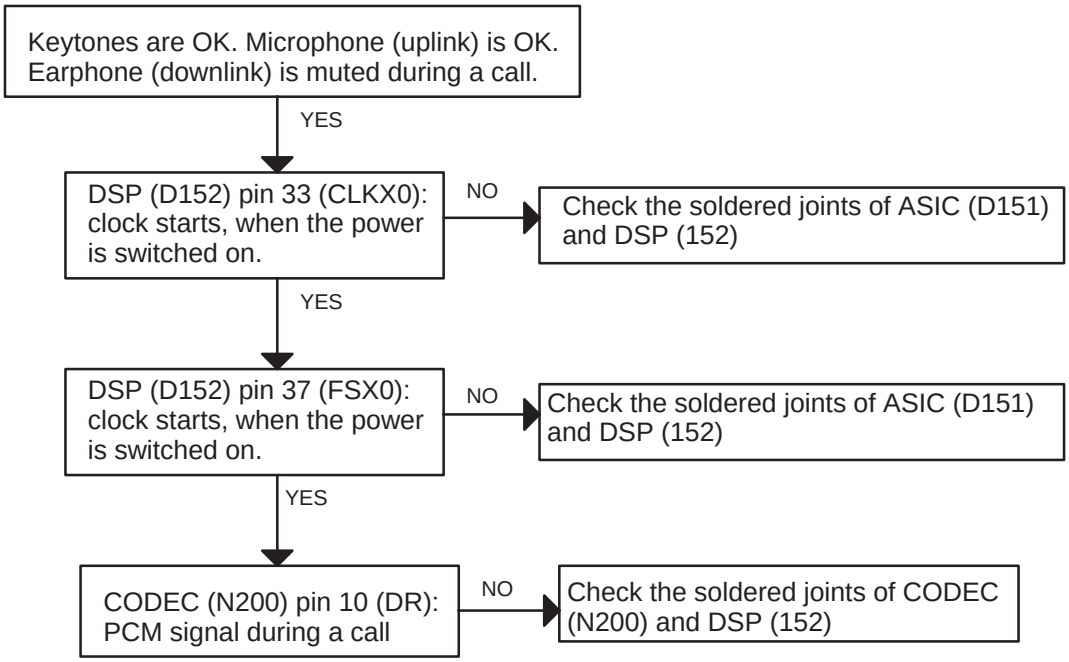
In cases that audio routings are totally muted, a fault could be in serial bus. This serial bus is used for PSCLD (N301) and for Display driver also, so if the PSCLD and the display are OK, there are open pins in the AUDIO CODEC (N200) or the AUDIO CODEC is faulty.

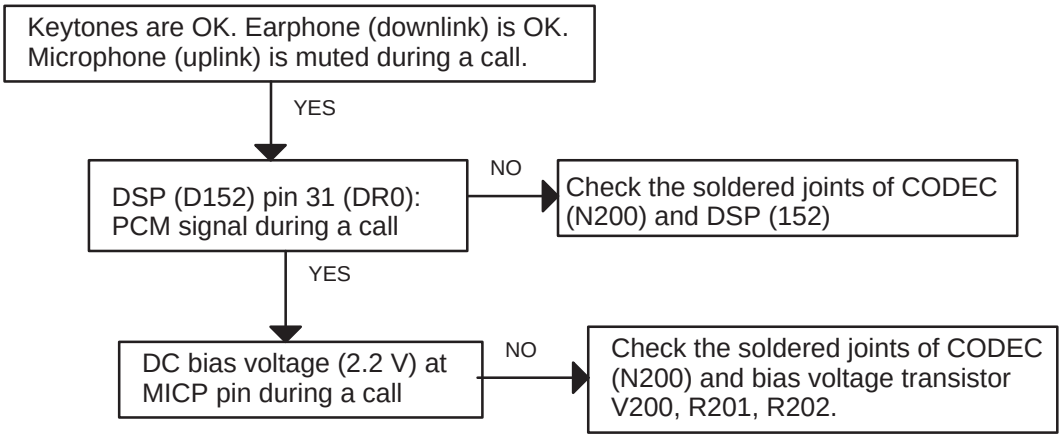
Serial bus faults can be found with PCLocals software (self test).

Other possibilities are that PCM clock and sync lines are open. CODEC (N200), ASIC (D151) and DSP (D152) must be checked (see figure 27).


Keytones are missing and the earphone and the micro-phone are muted during a call.
YES
CODEC (N200) pins 2,3,15 (VA): 3.16 V
NO
Check the soldered joints of PSCLD (N301). If OK, change N301
YES
Check Audio interface with the PClocals software.
Result: Fault
CODEC (N200) pin 11 (CCLK): pulses up to ”1”, when the power is switched on.
CODEC (N200) pin 12 (CSX): pulses down to ”0”, when the pow-er is switched on.
CODEC (N200) pin 13 (CDI): pulses up to ”1”, when the power is switched on.
Result: OK
NO
ASIC (D151) pin 40 (PCMDCLK): clock starts, when the power is switched on.
Check the soldered joints of ASIC (D151). If OK, change D151.
YES
YES
NO
Check the serial bus lines to the ASIC (D151)
Check UI board and connector X101
Change CODEC (N200)


Keytones are OK. The earphone and the microphone are muted during a call.
YES
ASIC (D151) pin 41 (PCMSCLK): clock starts, when the power is switched on.
NO
Check the soldered joints of ASIC (D151). If OK, change D151.
YES
DSP (D152) pin 29 (FSR0): clock starts, when the power is switched on.
NO
Check the soldered joints of ASIC (D151) and DSP (D152).
YES
DSP (D152) pin 27 (CLKR0): clock starts, when the power is switched on.
NO
Check the soldered joints of ASIC (D151) and DSP (D152).


Keytones are OK. Microphone (uplink) is OK. Earphone (downlink) is muted during a call.
YES
DSP (D152) pin 33 (CLKX0): clock starts, when the power is switched on.
NO
Check the soldered joints of ASIC (D151) and DSP (152)
YES
DSP (D152) pin 37 (FSX0): clock starts, when the power is switched on.
NO
Check the soldered joints of ASIC (D151) and DSP (152)
YES
CODEC (N200) pin 10 (DR): PCM signal during a call
NO
Check the soldered joints of CODEC (N200) and DSP (152)


Keytones are OK. Earphone (downlink) is OK.
Microphone (uplink) is muted during a call.
YES
DSP (D152) pin 31 (DR0):
PCM signal during a call
NO
Check the soldered joints of CODEC
(N200) and DSP (152)
YES
DC bias voltage (2.2 V) at
MICP pin during a call
NO
Check the soldered joints of CODEC
(N200) and bias voltage transistor
V200, R201, R202.

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After Sales Technical Documentation

NHE–5 TUNING INSTRUCTIONS

Original, 46/95

NMP PArt No. 0275077

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

TUNING INSTRUCTIONS

Contents

Introduction	Page 4
General	Page 4
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Equipment Setup	Page 5
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Introduction

General

In contrast to earlier second–generation analog cellular phones almost all tuning operations of the NHE–5 are carried out using the service software. The service software turns the phone into the locals mode, in which the phone can be outwardly controlled via the M2BUS interface.

Tuning is based on the software communicating with the D/A and A/D converters of the phone. In some instances the phone processor will also calculate the required correction parameter.

The tuning values of the phone reside on the EEPROM. The contents of the EEPROM can be read by the service software and saved as a file. This is advisable when there is need to retain that information, e.g. in view of replacement of the circuit. The program also enables writing the default parameters on the EEPROM, in which case all tuning steps should be carried out.

N.B. **During tuning, proceed as follows:**

– Take care not to damage sensitive measuring instruments with excessive RF power.

– Carry out all tuning steps in the shortest possible time to avoid excessive heating of RF units.

– Perform all tuning steps in the order presented.

– Never try to mask a fault by tuning it out!

Required Equipment

- PC/AT computer with service software; see Sect. 5 for intructions on installation and use.
- M2BUS adapter DAU–4S and other service accessories; see equipment set-up pictures.
- Multimeter or DVM.
- GSM radio telephone test station or separate measuring equipment as follows:
    - RF generator
    - pulse power meter
    - spectrum analyzer
    - attenuator and branching unit

Equipment Setup

Caution: Make sure that you have switched off the PC and the printer before making connections !

Caution: Do not connect the PKD–1 key to the serial port. You may damage your PKD–1 !

Attach the protection key PKD–1 to parallel port one (25–pin female D–connector) of the PC. When connecting the PKD–1 to the parallel port be sure that you insert the PC end of the PKD–1 to the PC (male side). If you use a printer on parallel port one, place the PKD–1 between the PC and your printer cable.

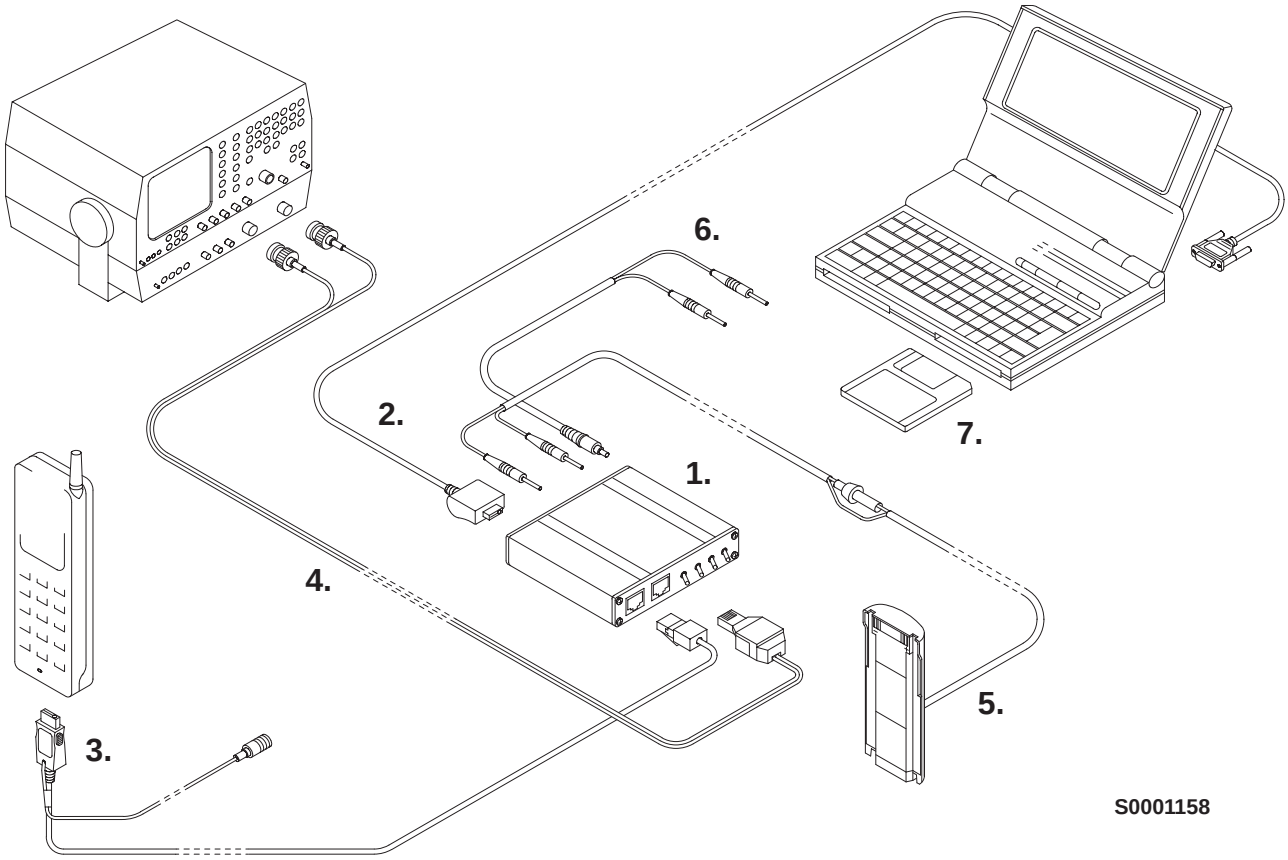
Next connect the M2BUS service cable, DAU–4S, to the serial port (RS–232) of the computer. Attach one end of the service cable to the PC serial port and the other end to the service box, JBU–4. For servicing the phone with the covers in place the service box should always be used.

The RF cable should be connected between the RF connector of the test set and the appropriate connector on JBU–4. When the phone covers are removed the RF connection on the extension cable should be used instead.

For audio measurements connect the service cable, SCS–4, as follows:

– EAR line to AF INPUT of test equipment
– MIC line to MOD GEN OUTPUT of test equipment

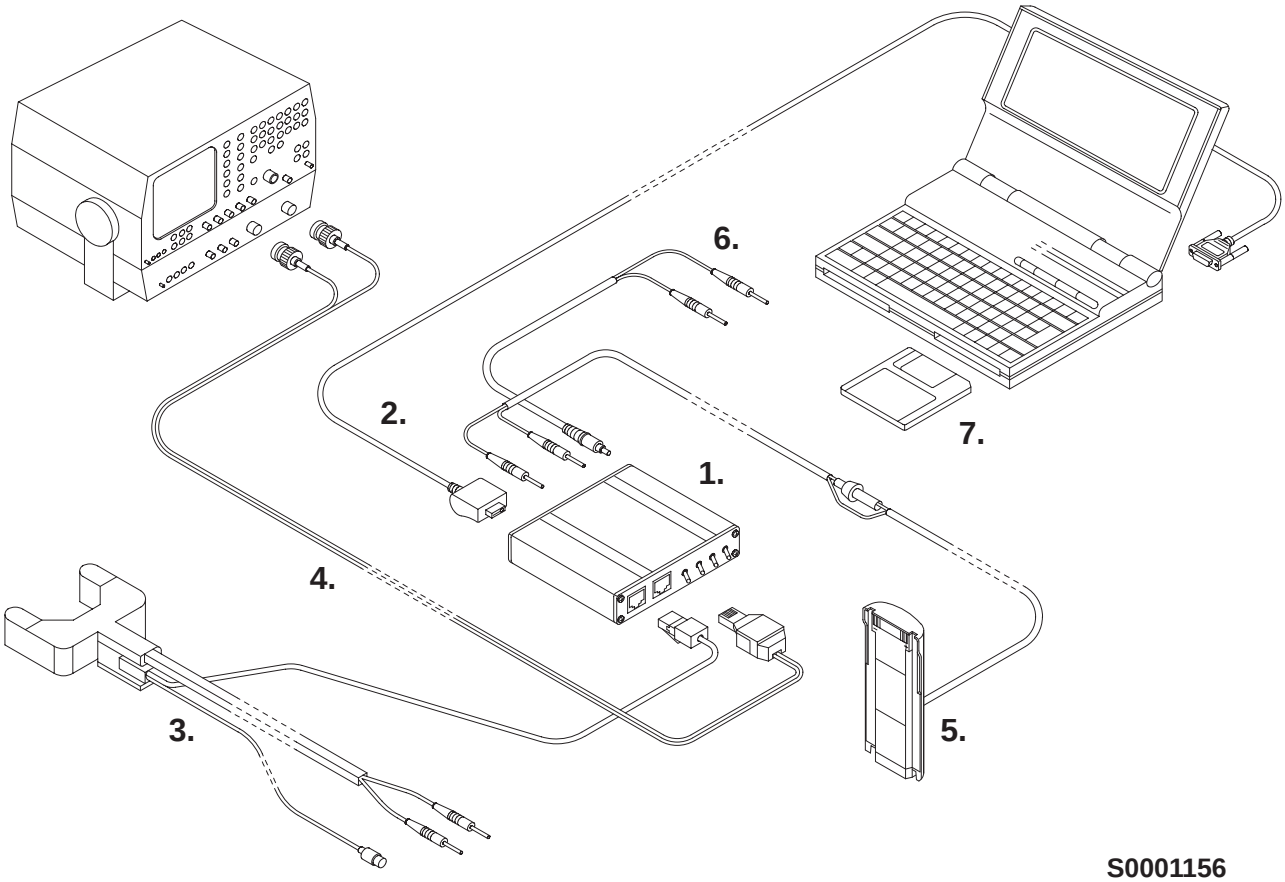
Equipment Setup For Tuning A Phone Without Removing Covers



Item:	Service accessory:	Product code:
1.	Service box, JBU–4	0770041
2.	M2BUS adapter cable, DAU–4S	0730057
3.	Service cable, SCS–4	0730052
4.	Audio cable, ADS–1	0730011
5.	Service battery, BBS–1	?
6.	Power connector, PCS–1	0730012
7.	Service software diskette 3.5”,	0774034
–	Service software diskette 5.1/4”	0774035
–	Software protection key PKD–1 ”dongle”	0750018
–	Antenna adapter, AAT–2 *)	0310016

*) Note: Be very careful when you install the antenna adapter AAT–2. The antenna clip in the phone can be damaged very easily

Equipment Setup For Tuning A Phone With Removing Covers



S0001156

Item:	Service accessory:	Product code:
1.	Service box, JBU–4	0770041
2.	M2BUS adapter cable, DAU–4S	0730057
3.	Module jig, JBS–14	0770049
4.	Audio cable, ADS–1	0730011
5.	Dummy battery, BBS–1	?
6.	Power connector, PCS–1	0730012
7.	Service software diskette 3.5”,	0774034
–	Service software diskette 5.1/4”	0774035
–	Software protection key PKD–1 ”dongle”	0750018

Starting The Software

The software is delivered on a diskette and is copy protected with a dongle. The software must be installed on the hard disk, see installation instructions in Service Software User's Guide.

Starting steps:

– Start Windows
– Open NMP Service Software Group
– Start software by double–clicking NHE–5 Service PCLocals icon
– When Login windows appears press *OK* button
– Choose from main menu *Product –> New.*

Tuning Steps

1. RSSI Reference Signal Level Storage

Reference value for the received signal strength meter are program tuned.

RSSI reference signal level programming:

– Select *Tuning –> RSSI (AGC)....*
– Connect RF generator to antenna connector at 947.067710 MHz.
– Adjust signal generator level to –80 dBm + cable attenuation.
– Press *OK* button
– Adjust signal generator level to –55 dBm + cable attenuation.
– Press *OK* button.
– Values should be below ±3.0 dB.
– Press *OK* button.

2. AFC Diagram Storage

This tuning is used to calibrate the automatic frequency control range.

AFC tuning:

– Select *Tuning –> AFC...*
– Set RF generator frequency 947.067710 MHz at level –55 dBm + RF cable attenuation.
– Check that ”Cont. mode channel” is 60
– The measurement result should be;
  - Low over < –20 kHz
  - Middle ±3.0 kHz (depends on generator frequency accuracy)
  - High below > 20 kHz
– Press *OK* button.

3. I/Q Modulator Amplitude Balance and Phase Shift Tuning

The purpose of this tunig operation is to adjust the I/Q modulator d.c. offsets and the I/Q modulator amplitude balance and phase shift.

I/Q modulator d.c. offsets, amplitude balance and phase shift tuning:

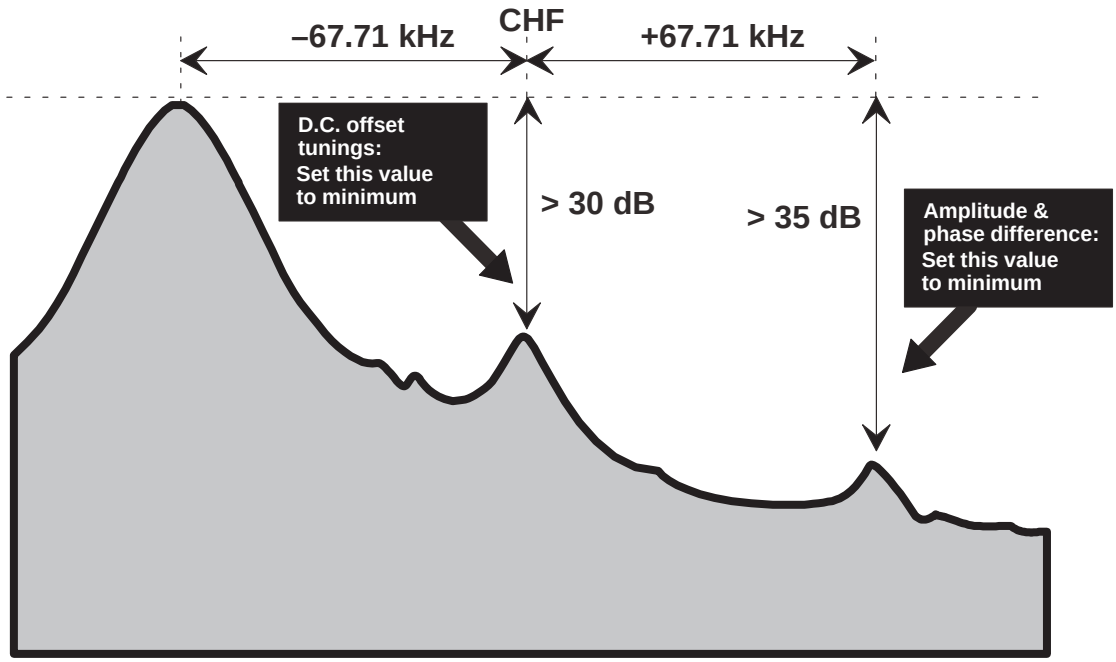
– Select *Tuning –> TX I/Q...*

– Select I/Q tuning values from PC's memory, phone's EEPROM or factory default values.

– Connect spectrum analyzer (with attenuator if needed) to phone antenna connector.

– Check that TX power level is level 15, Cont. mode channel is 60 and TX data type is 1.

– Adjust spectrum analyzer centre frequency to 902 MHz, Span 200 kHz, Res BW 10 kHz, Video BW 1 kHz and Sweep time 0.5 s.


–67.71 kHz
CHF
+67.71 kHz
D.C. offset tunings: Set this value to minimum
> 30 dB
> 35 dB
Amplitude & phase difference: Set this value to minimum

– Select option "TX I d.c. offset".

– Adjust the level of centre frequency (CHF signal) to minimum by varying D/A converter value with <– and –> buttons.

– The amplitude difference between CHF–67.7 kHz and CHF should be >30 dB.

– Select option "TX Q d.c. offset".

– Adjust the level of signal CHF to minimum by varying D/A converter value with <– and –> keys.

– Select option ”Tune Amplitude Difference”.
– Adjust the level of signal CHF+67.7 kHz (902.06777 MHz) to minimum by varying D/A converter value with <– and –> keys.
– The amplitude difference between CHF+67.7 kHz and CHF–67 kHz should be >35 dB.
– Select option ”Tune Phase Difference”.
– Adjust the level of signal CHF+67.7 kHz to minimum by varying D/A converter value with <– and –> keys.
– When values are correct press *OK* button.

4. Tuning of Transmitter Power Levels

This adjustment loads the power levels of the phone transmitter into the EEPROM. When doing this, a pulse power meter or spectrum analyzer must be used.

Power levels programming:

– Select *Tuning –> TX Power...*

– Select I/Q tuning values from PC's memory, phone's EEPROM or factory default values.

– Set power supply voltage to 6.0 V.

– Connect pulse power meter or spectrum analyzer to antenna connector.

– Check that continuous mode channel 60.

– Adjust the power level (levels 5, 13 and 15) with + and – buttons and change levels with ↑ and ↓ keys.

Power level	**Tuning P_{OUT}/dBm (VB=6.0 V, CH60)**
5	33
13	17
15	13

– Press *Calculate* button to calculate all other levels.

– Once all TX levels are correct, press *OK* button.

5. Charge Voltage Adjustment

A reference value for charge voltage is set by using an accurate 6.0 V supply.

Calibration of the charge voltage:

– Select *Tuning –> Charger A/D...*
– In case the phone covers are not removed replace the standard battery of the phone with the service battery BBS–1.
– Apply +6 V to VCHARG line.
– Software reads 6 V, A/D reading fed to phone VCHARG line.
– Store charge voltage value to phone EEPROM by pressing *OK* button.

6. Battery Voltage Adjustment

A reference value for battery are calibrated by using an accurate 6 V supply.

Calibration of the A/D converter channels:

– Select *Tuning –> Battery A/D...*
– In case the phone covers are not removed replace the standard battery of the phone with the dummy battery BBS–1.
– Apply +6 V to service battery.
– Software reads 6 V, A/D reading fed to phone VBAT line.
– Store correct value to phone EEPROM by pressing *OK* button.

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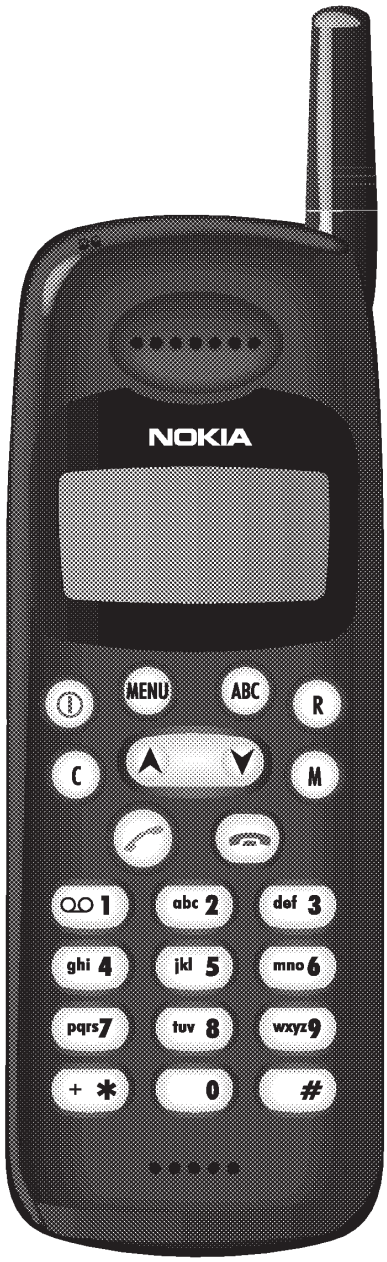
After Sales Technical Documentation

Appendix 2
TRANSCEIVER NHE–5NY

NMP Part No. 0275069

After Sales Technical Documentation

Appendix 3
TRANSCEIVER NHE–5NA



Original 32/96

NMP Part No. 0275070

After Sales Technical Documentation

Appendix 1
TRANSCEIVER NHE–5NX

NMP Part No. 0275068

After Sales Technical Documentation

NHE–5 SERIES
CORE TRANSCEIVER

NMP Part No. 0275067

After Sales Technical Documentation
NHE–5 Series Transceiver

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Amendment Record Sheet

Chapter 1	Foreword
Chapter 2	Technical Information
Chapter 3	Transceiver Overview
Chapter 4	System Module

Original 06/96

After Sales Technical Documentation
NHE–5 Series Transceiver
AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

After Sales Technical Documentation

NHE–5/NHK–5
ACCESSORY OVERVIEW

Original 32/96

NMP Part No. 0275071

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

NHE–5/NHK–5 ACCESSORY OVERVIEW

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Introduction

The following is a list of all available accessories for the NHE–5 series of hand-portable phones (covering all variants) together with their Product/Module codes.

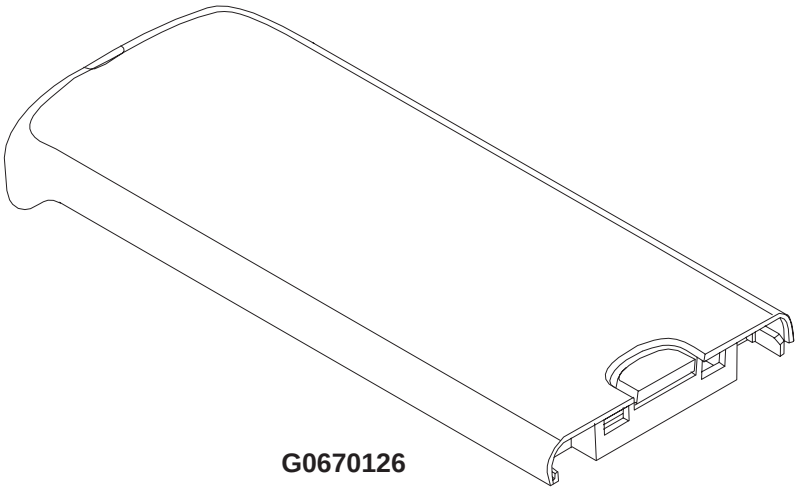
List of Accessories

Battery Pack BBT–7S and BBT–3S

Product Code

Battery pack BBT–7S:	*0670126*
Battery pack BBT–3S:	*0670125*

View of Battery Pack



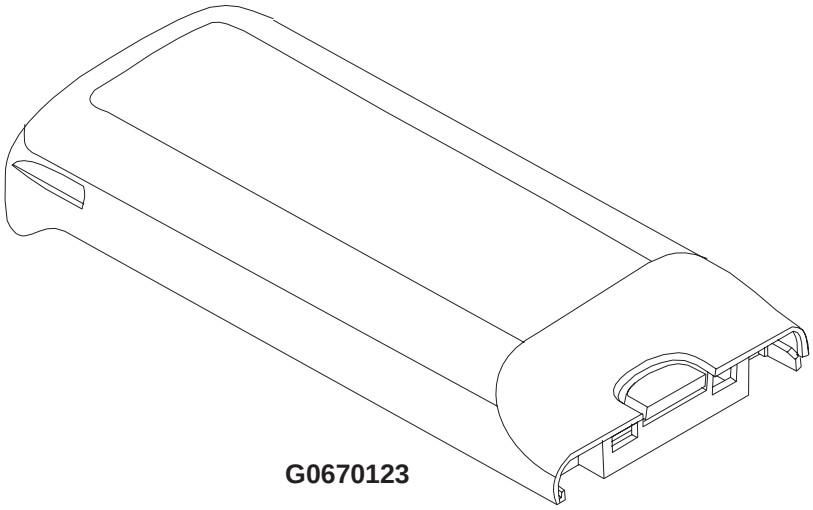
G0670126

Battery Pack BBT–2S and BBT–2H

Product Code

Battery pack BBT–2S:	*0670123*
Battery pack BBT–2H:	*0670124*

View of Battery Pack



G0670123

Standard Charger ACH–8

Product Codes

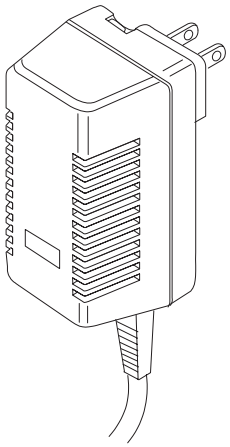
Standard charger ACH–8U (USA plug): *0675091*

Standard charger ACH–8E (Euro plug): *0675089*

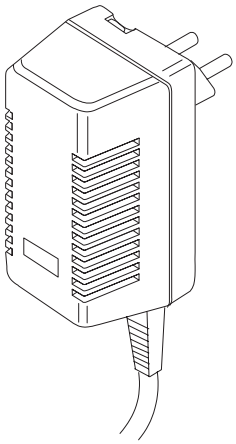
Standard charger ACH–8X (UK plug): *0675090*

View of Standard Chargers

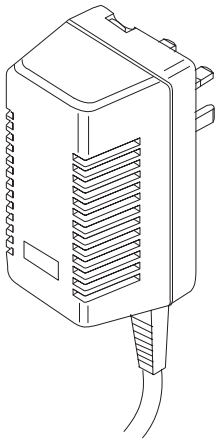
ACH–8U



ACH–8E



ACH–8X



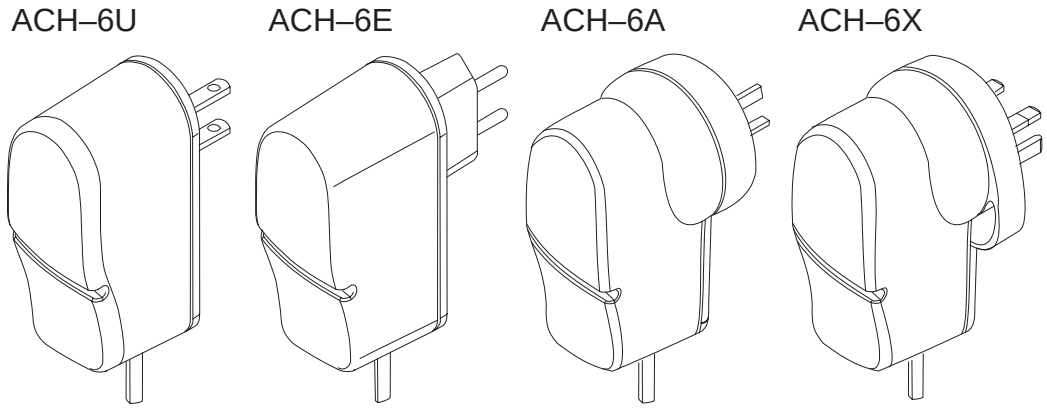
S0001160

Fast & Light Charger ACH–6

Product Codes

Fast & light charger ACH–6U (USA plug):	*0675085*
Fast & light charger ACH–6E (Euro plug):	*0675084*
Fast & light charger ACH–6A (Austr. plug):	*0675086*
Fast & light charger ACH–6X (UK plug):	*0675087*
Output cable PCC–1 (supplied with ACH–6):	*0730076*

View of Fast & Light Chargers



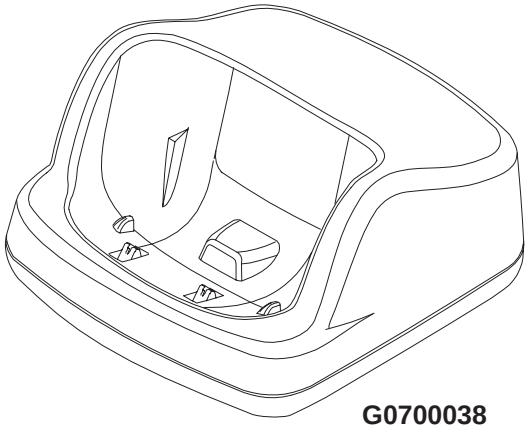
S0001161

Basic Stand CGH–2

Product Code

Basic stand CGH–2: *0700038*

View of Basic Stand



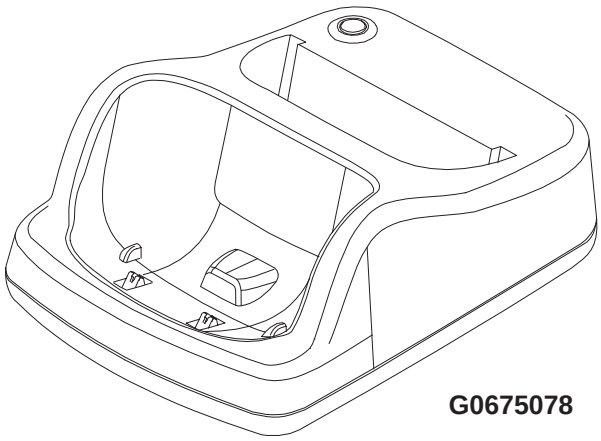
G0700038

Desktop Stand CGH–1

Product Code

Desktop stand CGH–1: *0675078*

View of Desktop Stand



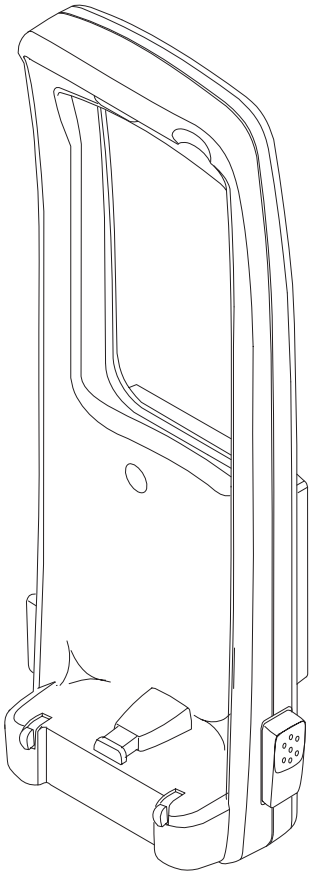
G0675078

Phone Holder MBT–2

Product Code

Phone holder MBT–2: *0620028*

View of Phone Holder



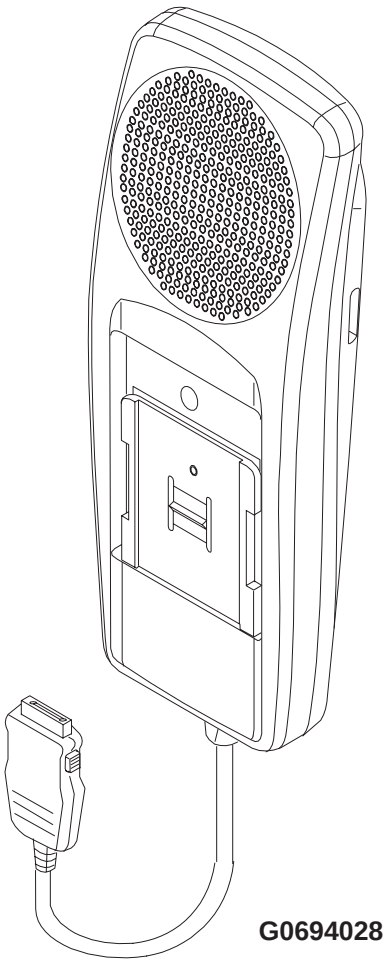
G0620028

Basic Handsfree Unit PHF–5

Product Code

Basic handsfree unit PHF–5: *0694028*

View of Compact Handfree Unit



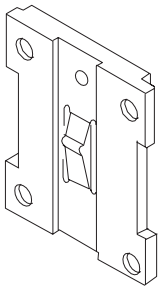
G0694028

Mounting Plate MKE–7

Product Code

Mounting plate MKE–7: *0650021*

View of Mounting Plate



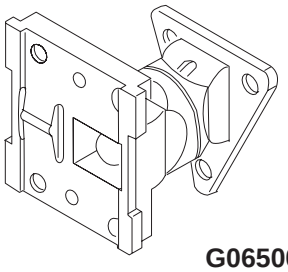
G0650021

Swivel Mounting Plate HHS–7

Product Code

Swivel mounting plate HHS–7: *0650020*

View of Swivel Mounting Plate



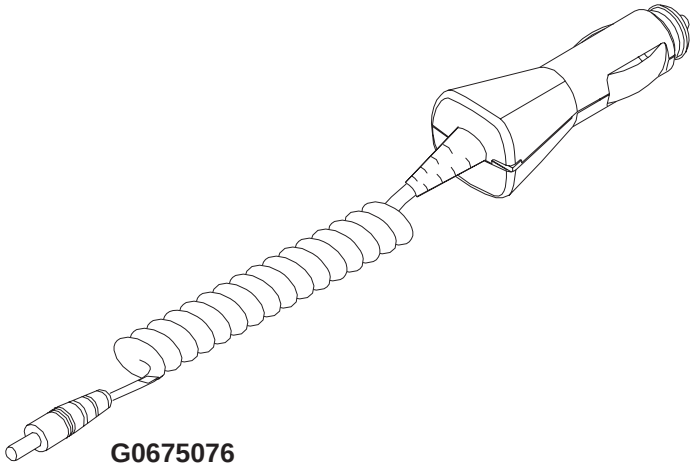
G0650020

Universal Mobile Charger LCH–6

Product Code

Universal mobile charger LCH–6: *0675076*

View of Universal Mobile Charger



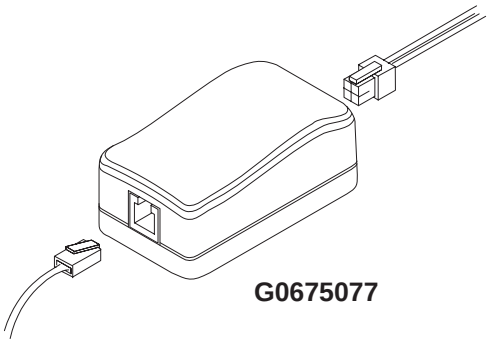
G0675076

Fixed Mobile Charger LCM–1

Product Code

Fixed mobile charger LCM–1:	*0675077*
Output cable PCC–1 (supplied with LCM–1):	*0730076*

View of Fixed Mobile Charger



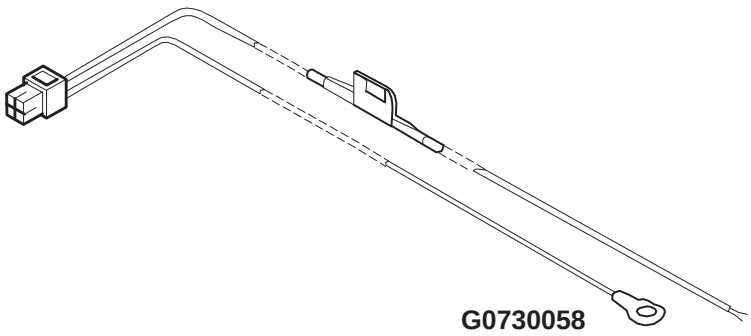
G0675077

Power Cable PCM–5

Product Code

Power cable PCM–5: *0730058*

View of Power Cable



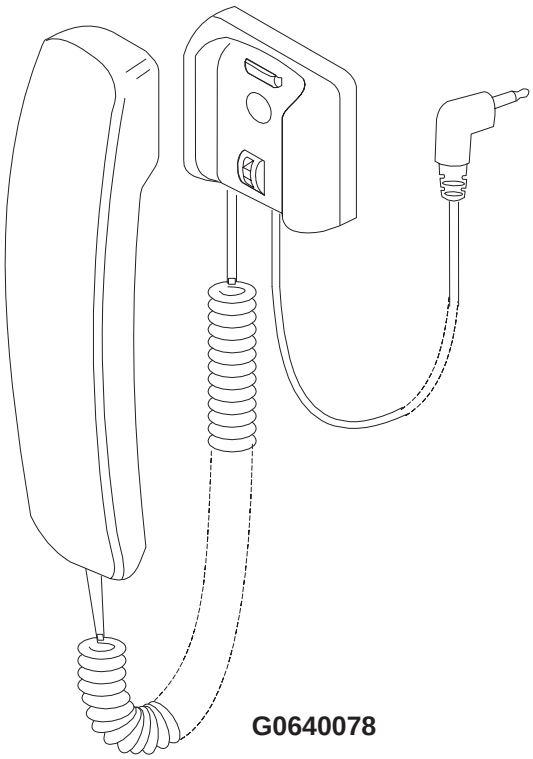
G0730058

Handset HSU–2

Product Code

Handset HSU–2: *0640078*

View of Handset HSU–2



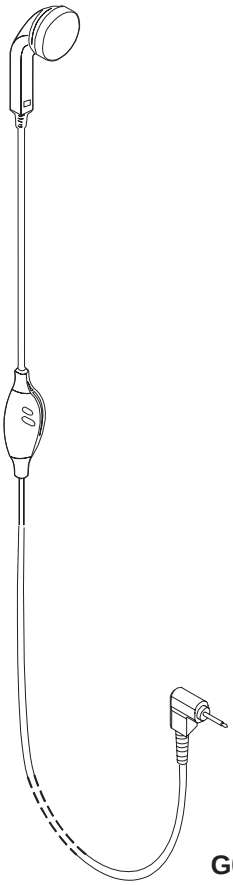
G0640078

Headset HDC–2

Product Code

Headset HDC–2: *0694017*

View of Headset



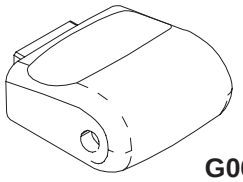
G0694017

Headset Adapter HDA–4

Product Code

Headset adapter HDA–4: *0694042*

View of Headset Adapter



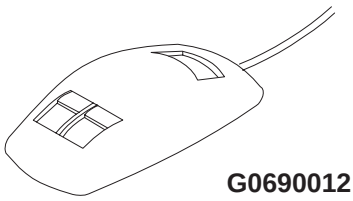
G0694029

Handsfree Microphone HFM–7

Product Code

Handsfree microphone HFM–7: *0690012*

View of Handsfree Microphone



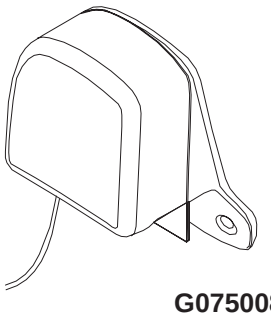
G0690012

External Antenna Adapter AAE–1

Product Code

External antenna adapter AAE–1: *0750080*

View of Antenna Adapter



G0750080

After Sales Technical Documentation

NHE–5/NHK–5 DISASSEMBLY INSTRUCTIONS

Original 06/96

NMP Part No. 0275075

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

NHE–5/NHK–5 DISASSEMBLY INSTRUCTIONS

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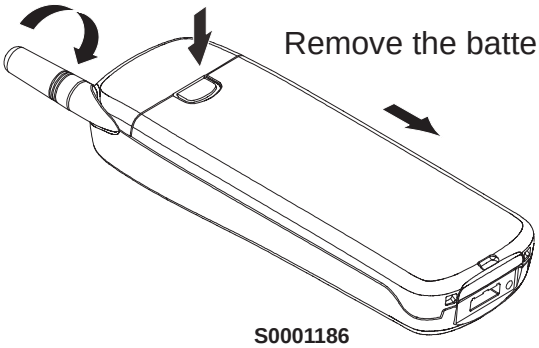
Disassembly Instructions

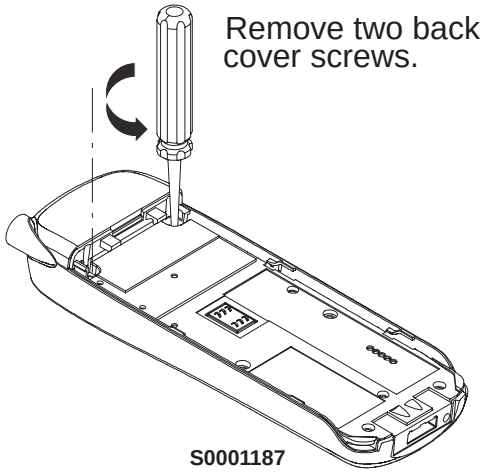
Remove the antenna.

Remove the battery.



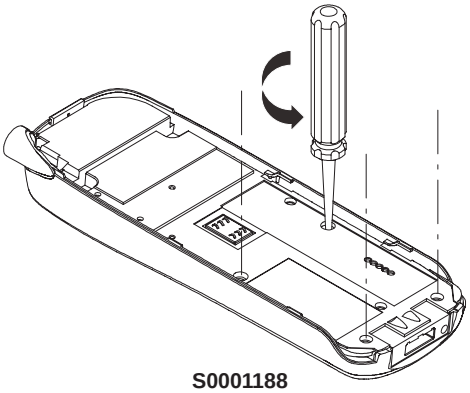
S0001186

Remove two back cover screws.



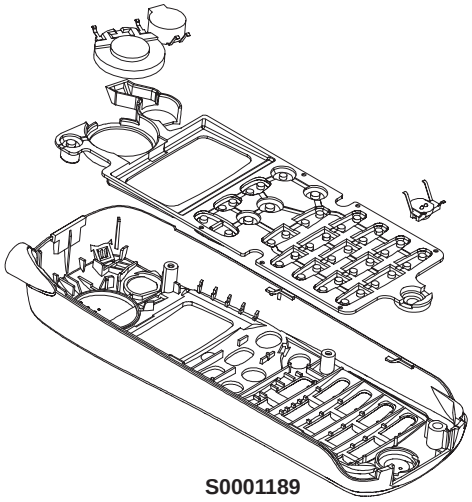
S0001187

Then remove four chassis screws.



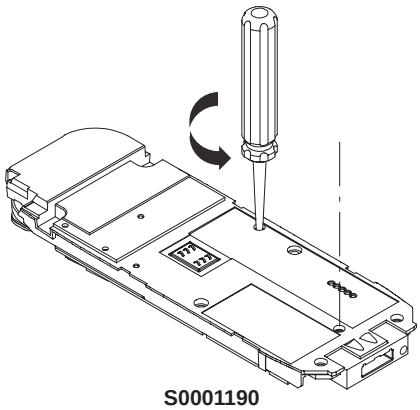
S0001188

Now the keyboard rubber and audio components can be lifted off.



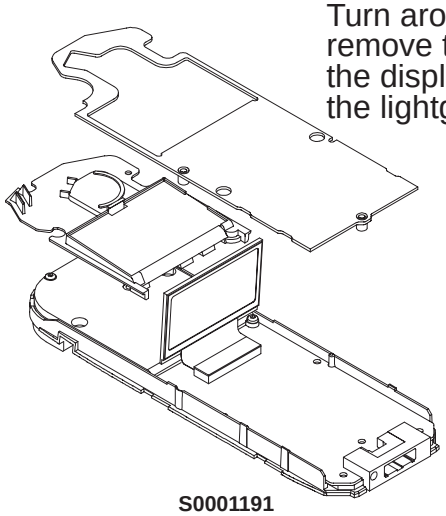
S0001189

Then unscrew two UI module screws.



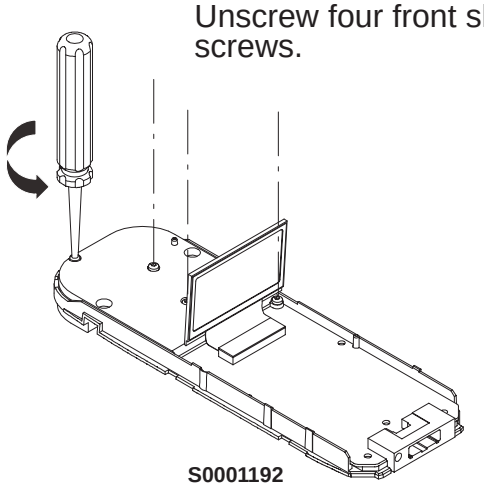
S0001190

Turn around the chassis, remove the UI module, tilt the display and remove the lightguide.



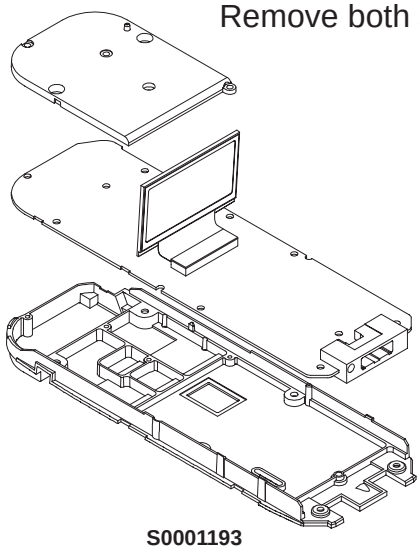
S0001191

Unscrew four front shield screws.



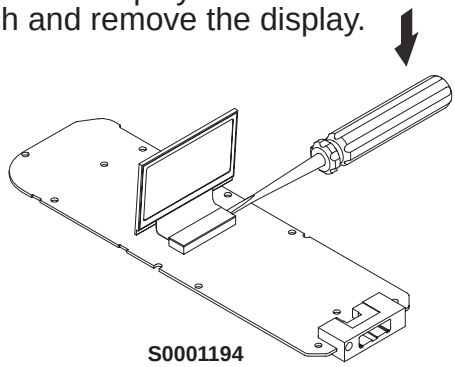
S0001192

Remove both shields.



S0001193

Open the display connector latch and remove the display.



S0001194

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After Sales Technical Documentation

NHE/K–5/6 SERVICE SOFTWARE INSTRUCTIONS

Original 03/97

NMP Part No. 0275074

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

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Introduction

General

The NHE/K–5 NHE/K–6 Service Software is specially designed to facilitate the servicing of sixth generation cellular telephones.

The software can be used to control the phone according to the user's requirements merely by entering commands via the keyboard or mouse of a PC connected to the phone.

This section refers to the Service Software Version 2.3. NMP After Sales will notify service personnel about future upgrades via Technical Bulletins. Software upgrades will be available from your local NMP outlet.

Minimum Required Servicing Equipment

- Computer: Intel 386/33 MHz or compatible with one unused serial port (COM1 or COM2*), one parallel port (LPT1), hard disk recommended.
- Memory: 4 MB or more
- Operating System: DOS Version 5 & Microsoft Windows 3.11 or later
- Display: VGA based display (640 x 480)
- PC Locals program: for 3.5" disk (product code: 0774034)
- Software Protection Key PKD–1 (product code 0750018)
- M2BUS interface cable DAU–4S (product code 0730057)

*) Note: A number of PC's of an older generation use the Intel, National Semiconductor, or United Microelectronics IC 8250 as the serial port UART. This is a comparatively inefficient circuit for current purposes and does not necessarily support the M2BUS adapter at 9600 baud. The newer UART's NS16450 and NS16550AF of National Semiconductor offer solutions for these problems.

Mechanical Connections

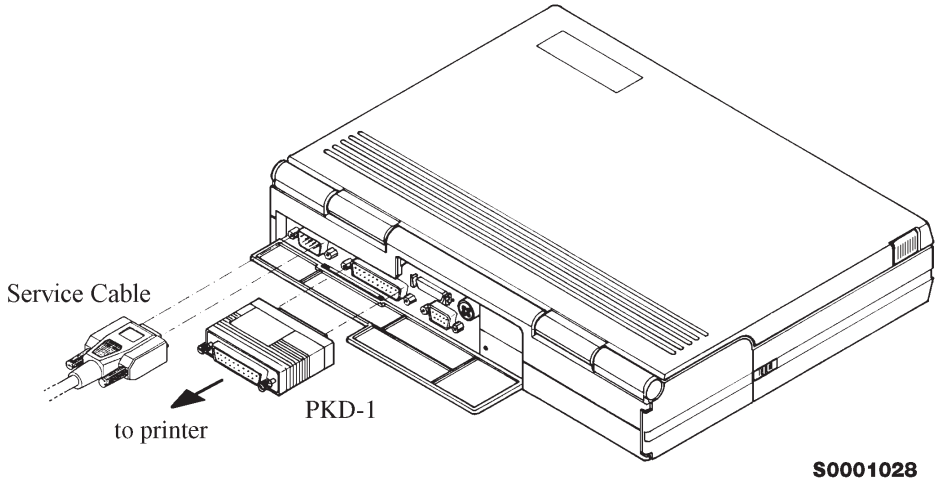
Caution: Ensure that you have switched off the PC and the printer before making connections !

Caution: Do not connect the PKD–1 to the serial port. This could damage the PKD–1 !

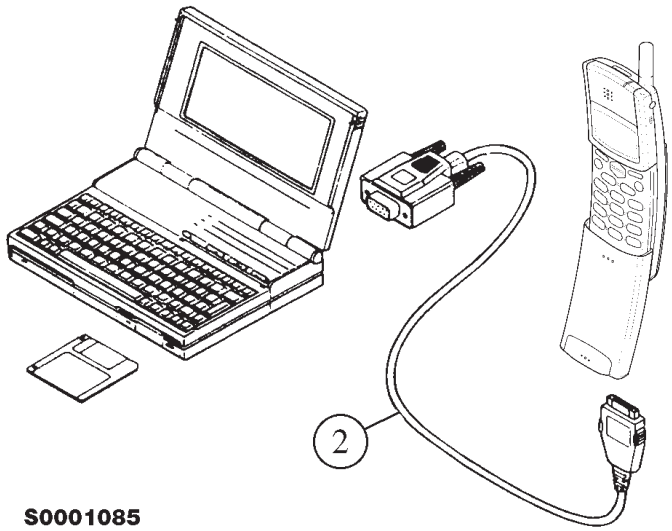
The software controls the phone via a separate adapter connected to the serial port of the PC and to the telephone's M2BUS (DAU–4S and XCM–1).

Attach the protection key PKD–1 to parallel port one (25–pin female D–connector) of the PC. When connecting the PKD–1 to the parallel port be sure that you insert the PC end of the PKD–1 to the PC (male side). If you use a printer on parallel port one, place the PKD–1 between the PC and your printer cable.

The PKD–1 should not effect devices working with it. If some errors occur (errors in printing are possible) please try printing without the PKD–1. If printing is OK without the PKD–1 please contact your dealer. We will offer you a new PKD–1 in exchange for your old one.



Attach one end of the M2BUS interface cable, DAU–4S (2), to the PC serial port and the other end to the bottom connector of the phone.



Start Up Procedure

Start the phone by pressing the power–on button of the handset. Switch PC power on.

To installing software, proceed as follows:

---

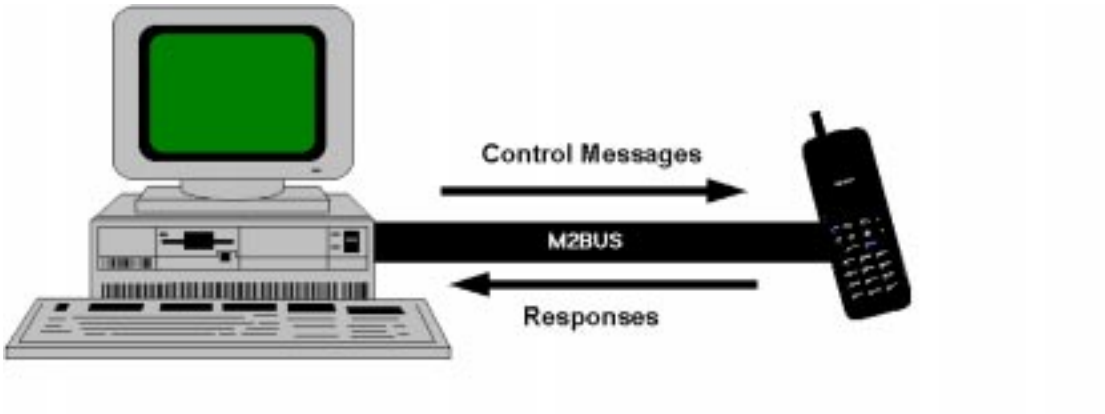
1. Insert Service Software disk into drive A of your PC
2. Start Windows: **type *WIN* and press *Enter***
3. Start Installing program: **select *File –> Run* from Program Manager menu, then type *A:INSTALL* and press *OK* button**
4. Follow Installation Software instructions

Introduction to Service Software Package User Interface

This chapter gives a short description of the Service Software properties.

Service Software/Hardware Enviroment

To run the Service Software, a parallel port software protection device (PKD–1) has to be connected. The user can use the Service Software functions for testing all supported Phone Types. The functions send messages from the PC to the phone, receives results and show them on the PC display. The messages are sent via a low level NMP proprietary bus protocol. An example bus is an M2BUS interface, which needs M2BUS adapter (DAU–2) connected to the PC RS–232 port and special M2BUS cable.



The recommended minimum hardware standard to run the Service Software package is any computer which is 386 33Mhz or greater with at least 4 MB of memory and VGA type display (640x480). This assumes that only the Service Software package is active, i.e. other Windows packages are not running in the background.

Note: if the Service Software is to be run on a laptop, the power saving feature MUST be switched off.

Service Software Enviroment

Service Software user interface is intended for Microsoft Windows 3.1x environment running in enhanced mode. For those who are familiar with Windows environment this application will be easy to use. Detailed information about Windows and application usage can be found from Ref 3– Microsoft Windows Version 3.1 Users Guide chapter one (Windows Basics) and chapter two (Application Basics).

As an ordinary Windows application, the main idea in the user interface is that selections are made with menus, push buttons and shortcut keys. Selections can be done by using keyboard and/or mouse. When messages from phone

are received, they cause display updating in special display windows. There is always a status bar displayed at the bottom of the main window which contains information about current actions.

Service Software Executables

Only one executable is needed – WinTesla.

For NHE/K–5/6 there are two DLL's:

– Functionality DLL is NHEK56.DLL

– User Interface DLL is NHEK56EN.DLL or NHK5EN.DLL

Command Line Parameters

There are NO command line parameters.

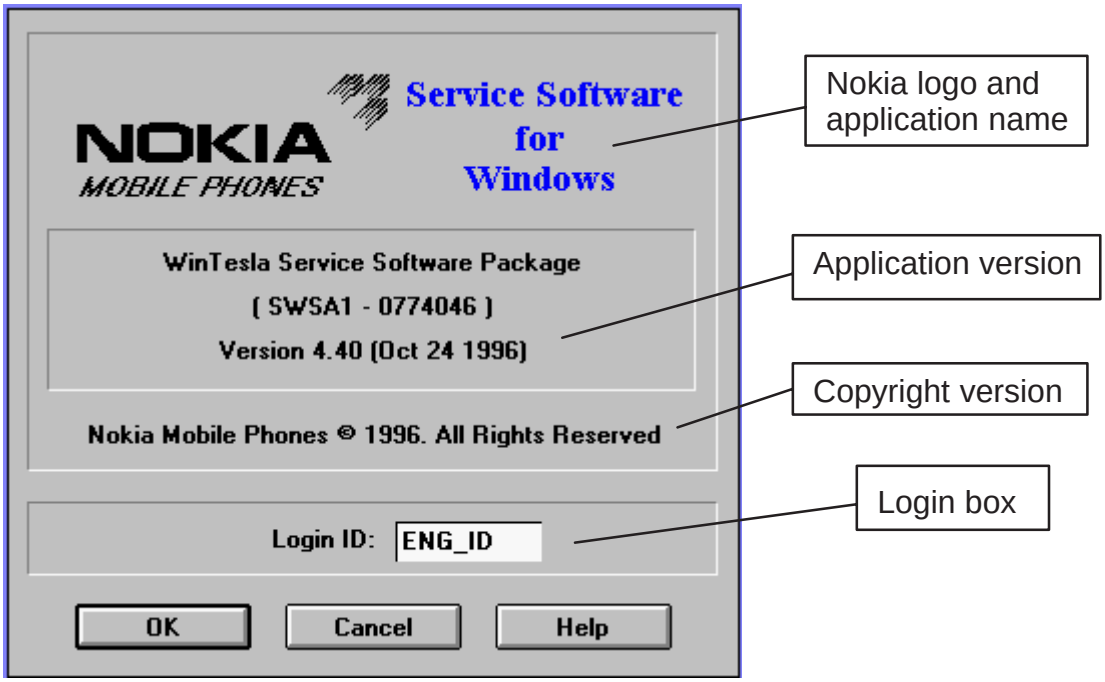
Common Properties of the User Interface

This chapter describes how the User Interface CLF must appear to the user.

The User Interface MUST be capable of being driven without the use of a mouse, as the service engineer rarely has space on the bench to use a mouse.

Login Dialog

When the Service Software application is invoked, by checking on the Service Software icon, the **Login** dialog box will be displayed on the screen.



Nokia logo and application name bitmap (–)

Displays Nokia logo and name of the application.

Application version static text (–)

Contains the name and version of the application.

Copyright notice static text (–)

Copyright is informed as: “**Nokia Mobile Phones (c) 1996. All Rights Reserved**”.

Login Box edit box (–)

The user Login ID edit box, where the user enters his faultlog user name. (See Faultlog User Guide)

OK button (default key)

The user name is stored in memory and the dialog box is closed. When the dialog box is closed, the application starts.

Cancel button (ESC)

The Dialog box is closed and application is started, but the Faultlog feature is disabled.

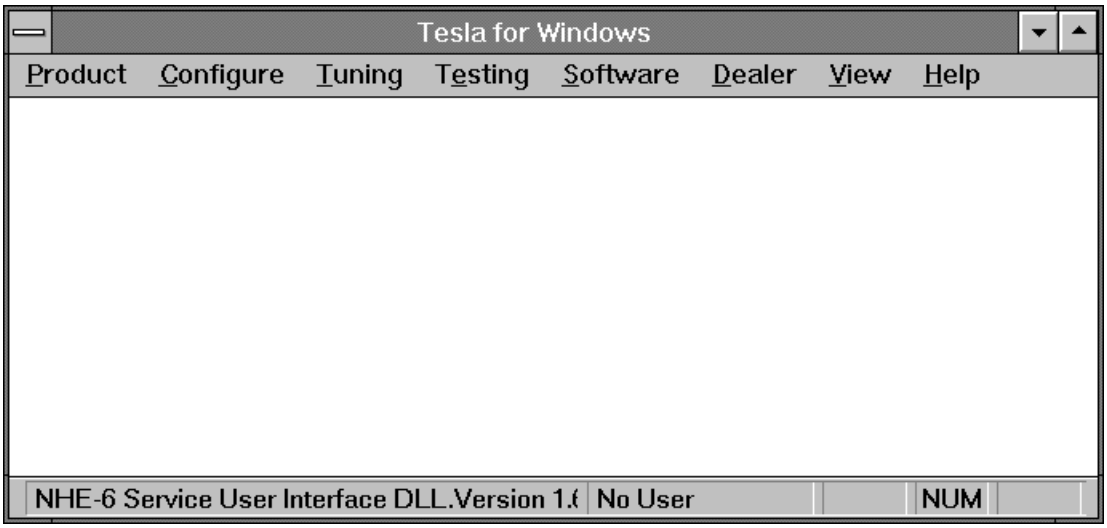
Help button (F1)

Activates the Windows Help application and displays context sensitive Help.

Main Window

The application supports a *Multiple Document Interface (MDI).* However, the service software interface will present a *Single Document Interface (SDI)* appearance.

Note: MDI is to allow for future expansion, e.g. R&D features.



Title bar

The *title bar* is located at the top of the window.

A title bar contains the following elements:

- Application Control–menu button
- Maximise button
- Minimise button
- Name of the application
- Restore button

The properties of these elements and their usage is described in Ref 3– Microsoft Windows Version 3.1 Users Guide chapter one (Windows Basics) and chapter two (Application Basics).

Menu bar

The *menu bar* is below the title bar and contains all available menu selections. The menu bar is a dynamic element and is dependent on the dongle type fitted, and whether a phone is connected.

Underlined characters in menu names and options indicates that the menu selection can be done by pressing *Alt*+ *underlined character*. Options can also be selected by activating menu bar with *Alt*– key (or *F10* key) and using arrow–keys to highlight the desired menu. In that case, selection is done by pressing *Enter*.

Menus can also be selected by using the mouse as described in Ref 3–Microsoft Windows Version 3.1 Users Guide

Status bar

The *status bar* is displayed at the bottom of the Service Software main window. The status bar contains information about the menu selections and events.

The left area of the status bar describes the actions of menu items as the user uses the arrow keys to navigate through menus.

The status bar texts are explained in detailed in each of command's description.

The right areas of the status bar indicate which of the following keys are latched down:

Indicator	Description
USER	Entered Login ID.
CAP	The Caps Lock key is latched down.
NUM	The Num Lock key is latched down.
SCRL	The Scroll Lock key is latched down.

Tool bar

The *tool bar* is NOT defined and will not be implemented until specified by this document.

Menu Bar

The Service Software package will have two menu bar configurations. The first, is an abbreviated version that contains the minimum number of menus that allows package configurations when a phone is NOT connected. The second is described below:

The menu bar MUST only contain the follow menus for the Service Software package when a phone is connected:

- Product*
- Configure*
- Tuning
- Testing
- Software
- Dealer
- View
- Help*

* – always displayed, even if no phone is connected.

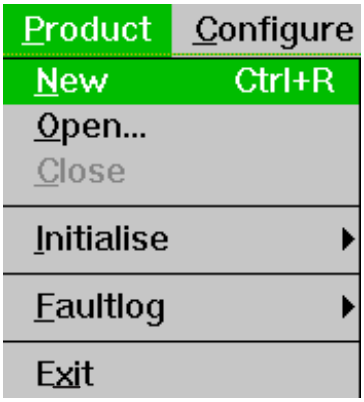
A menu is broken down into sections that are indicated with menu separators. Each sections identifies a logical difference from itself and other sections, i.e. between transmitter and receiver. Any items that are required to be added to a menu lists will be added on the bottom of the appropriate menu section list. If a new item is to be added which is common to two or more phone types, then that menu item will become a common menu item.

The menu lists will use the Microsoft [...] symbol after an item name to indicate that selecting that item will NOT initiate an operation immediately, i.e. a dialog box will be displayed for the user to select options or type in data and press the OK button before the operation is performed.

Product

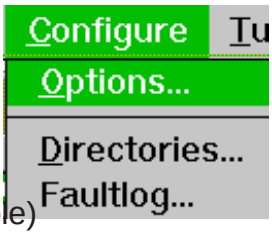
The Product menu contains the following menu items:

- New Ctrl+R
- Open...
- Close
- Initialize
  - Normal Mode F5
  - Local Mode Shift+F5
- Faultlog
  - Activate Faultlog... F9
  - Edit Faultlog...
- Exit Alt+F4



Configure

The Configure menu contains the following menu items:

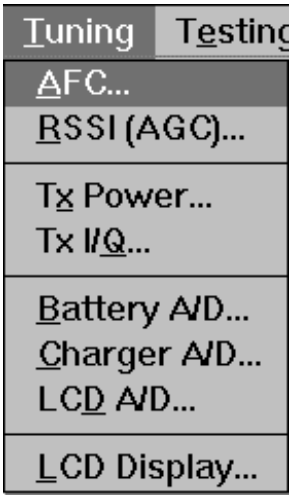


- Options...
- Directories...
- Faultlog...
- Phone Type Specific configuration items (where applicable)

Tuning

The Tuning menu contains the following menu sections:

- Receiver
- Transmitter
- Voltages
- Phone Type Specific tuning items (where applicable)



An example Tuning menu is shown below:

- AFC...
- RSSI (AGC)...
- Tx Power...
- Tx I/Q...
- Battery A/D
- Charger A/D...
- LCD A/D...
- LCD Display...

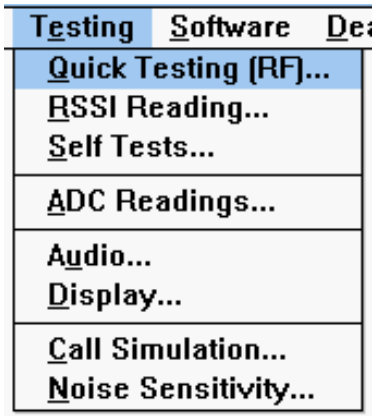
Additional menu items may be added within the sections according to the phone type being tuned, e.g. a Charger tuning menu item will be added after the Battery tuning item, but not in the Transmitter tuning section.

Testing

The Testing menu contains the following menu sections:

- Quick Tests
- Digital
- User Interface Flexi
- Transmitter
- Receiver
- Automatic Tests
- Phone Type Specific testing items (where applicable)

An example Testing menu is shown below:



- Quick Testing (RF)...
- RSSI Reading ...
- Self Tests
- ADC Readings
- Audio
- Display
- Call Simulation...
- Noise Sensitivity...

Additional menu items may be added within the sections according to the phone type being tested.

Where a menu item consists of more than one test, a pop–up menu may be added to identify the appropriate sub–tests, e.g. there may be two receiver tests required for a particular phone type (Bit Error Rate and RSSI Monitoring). These will be shown as a popup from the Receiver menu item.

Software

The Software menu contains the following menu sections:

- Phone Identity/Numbers
- Flashing
- Phone Type Specific software items (where applicable)

An example Software menu is shown below:

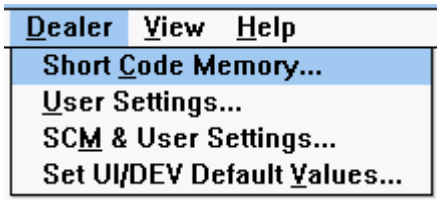
- Phone Identity
- Product Profile...
- Start Up Self–tests...
- Set Default Values
- Network Settings...
- HW Settings...
- Warranty State...
- Service Numbers...

Dealer

The Dealer menu contains the following menu sections:

- Phone UI Data Editors
- Phone UI Data Transfer
- Phone Re–Initialization Functions
- Subscriber Data
- Phone Type Specific dealer items (where applicable)

An example Dealer menu is shown below:



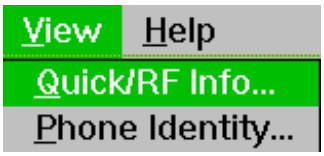
- Short Code Memory
- User Settings
- SCM & User settings ...
- Set UI/DEV Default Values ...

View

The View menu contains the following sections:

- Service Windows
- Production Windows (where applicable)
- R&D Windows (where applicable)

An example View menu is shown below:



- Quick/RF Info...
- Phone Identity...

Phone Identity Window

The Phone Identity window should contain, as a minimum, the following data:

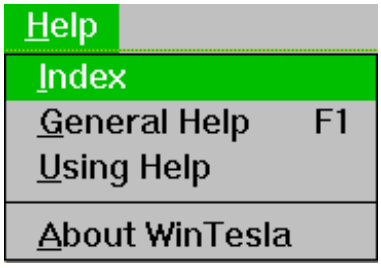
- Software Version(s)
- Hardware Version(s)
- Serial Number(s)
- Product Code

This window will only be used as a display window and therefore will not allow editing of the displayed data. This window will not contain any controls other than a scroll bar.

Help

The Help menu contains the following menu items:

- Index
- General Help
- Using Help
- About WinTesla



Mouse Cursors

The standards Windows pointer will be used as the mouse cursor.

During time consuming tasks e.g. communication to phone, an hour glass will be shown informing the user that a task is in progress. The application uses the hour glass cursor to inform user that the application has taken the control and any actions from user will be ignored.

When a function is initiated, the hour glass will be displayed and when the function has finished the mouse pointer will return to normal.

Reserved Keys

The following Hot keys and Short Cut keys are reserved either as Microsoft standard keys or as part of the Common Look and Feel specified by this document.

Short Cut Function Keys

Key	Description	Defined by
F1	Context Sensitive Help	Microsoft
F5	Normal Mode	NMP
Shift+F5	Local Mode	NMP
F9	Activate Faultlog	NMP
F10	Goto Menu Bar	Microsoft
Ctrl+F4	Close Active Window	Microsoft

Alt Hot Keys

Key	Description	Defined by
Alt+F4	Exit Active Application	Microsoft
Alt+H	Help	Microsoft

Ctrl Hot Keys

Key	Description	Defined by
Ctrl+N	File – New	Microsoft
Ctrl+O	File – Open	Microsoft
Ctrl+P	File – Print	Microsoft
Ctrl+R	Product – New	NMP

Shift Hot Keys

Key	Description	Defined by
Shift+F5	Local Mode	NMP

Key Strokes

Key	Description	Defined by
Alt+P	Product Menu	NMP
Alt+P,N	New	NMP
Alt+P,O	Open	NMP
Alt+P,C	Close	NMP
Alt+P,I	Initialize Pop–up	NMP
Alt+P,I,N	Normal Mode	NMP
Alt+P,I,L	Local Mode	NMP
Alt+P,F	Faultlog Pop–up	NMP
Alt+P,F,A	Activate Faultlog	NMP
Alt+P,F,E	Edit Faultlog	NMP
Alt+P,E	Exit Application	NMP
Alt+C	Configure	NMP
Alt+C,O	Option	NMP
Alt+C,D	Directories	NMP
Alt+C,F	Faultlog	NMP
Alt+T	Tuning Menu	NMP
Alt+T,A	AFC	NMP
Alt+T,R	RSSI(AGC)	NMP
Alt+T,X	Tx Power	NMP
Alt+T,Q	Tx I/Q	NMP
Alt+T,B	Battery	NMP
Alt+T,C	Charger	NMP
Alt+T,D	LCD A/D	NMP
Alt+T,L	LCD Display	NMP
Alt+E	Testing Menu	NMP
Alt+E,Q	Quick Testing RF	NMP
Alt+E,R	RSSI Reading	NMP

Alt+E,S	Self Tests	NMP
Alt+E,A	ADC Readings	NMP
Alt+E,U	Audio	NMP
Alt+E,D	Display	NMP
Alt+E,C	Call Simulation	NMP
Alt+E,N	Noise Sensitivity	NMP
Alt+S	Software Menu	NMP
Alt+S,I	Phone Identity	NMP
Alt+S,P	Product Profile	NMP
Alt+S,S	Start–up Self Tests	NMP
Alt+S,V	Set Default Values	NMP
Alt+S,N	Network Settings	NMP
Alt+S,H	HW Settings	NMP
Alt+S,W	Warranty State	NMP
Alt+S,B	Service Numbers	NMP
Alt+D	Dealer Menu	NMP
Alt+D,C	Short Code Memory	NMP
Alt+D,U	User Settings	NMP
Alt+D,V	Set UI Default Values	NMP
Alt+V	View Menu	NMP
Alt+V,Q	Quick/RF Info	NMP
Alt+V,P	Phone Identity	NMP
Alt+H	Help Menu	Microsoft
Alt+H,I	Index	Microsoft
Alt+H,G	General Help	Microsoft
Alt+H,U	Using Help	Microsoft
Alt+H,A	About WinTesla	Microsoft

Help Functions

The Help User Interface will be the standard Windows help tool called WinHelp.

The context sensitive help is activated with **F1**–key. Help contains also Using Help which describes how to use help facility. Refer to the Windows manual for detailed description on the Windows Help.

Dialog boxes

The Service Software application uses many different dialog boxes. Dialog boxes are used to display data and prompt the user for input.

Dialog boxes are opened from menus or with shortcut keys. Dialog boxes have different properties but some features are common.

All service dialog boxes must be modal, that is, the user will not be able to start another operation without first closing the present dialog box.

All dialog boxes will contain the following entities:

– Help button

– Title bar

– At least one button other than Help

– Application Control–menu Button

Common Dialog boxes

This sections describes the common dialog boxes used in the Service Software package, and the context in which they will be used.

Note Message Box

When the user has made an illegal selection, a *note message box* dialog will be opened and message text is displayed. The message box is also opened when the program has some information for the user. The size of the dialog box may vary. An information dialog box is recognized by the **!**–icon.

The dialog box will also contain an OK button and a Help button.

OK button (default key):

Acknowledge displayed information and continue. The dialog box is closed after selection.

Help button (Alt+H):

Opens context sensitive help as F1–key does.

Query Message Box

Confirmations and questions are asked in *a query message box*. A query dialog box is recognized by the **?**–icon.

The dialog box will also contain a Yes button, a No button, and a Help button.

Yes button (Alt+Y or Y) (default key):

Accepts confirmation or question.

No button (Alt+N or N):

Denies confirmation or question.

Help button (Alt+H):

Opens context sensitive help as F1–key does.

The buttons may also be OK and Cancel. The operation of these buttons are the same as in the Note dialog box.

Error Message Box

Error message dialog boxes use the Stop–icon. When a “Stop”–dialog box is shown, the current operation is terminated.

The dialog box has a description about the failed operation and reason. Pressing F1 (Help) application opens the appropriate help topic that gives information about recommended actions.

The dialog box will also contain an OK button and a Help button.

OK button (default key):

Acknowledges displayed information and terminate current operation. The dialog box is closed after selection.

Help button (Alt+H):

Open context sensitive help as F1–key does.

Custom Dialog boxes

All custom dialog boxes will contain the predefined buttons as defined below in the section – *Buttons.* However, it is recognised that features may require additional button types, but the addition of these non–standard buttons should be carefully considered to minimise any inconsistencies between implementations.

The buttons will be positioned down the right–hand side of the dialog boxes. The default action will be **OK**, except where that default action could result in an irretrievable failure.

All tuning dialogs that contain tuning results, will display the old tuned data read from the phone before the tuning was performed, as well as the newly tuned data.

List boxes will be used to display lists of data, such as tuning data, test results etc.

The use of Radio buttons should be limited and carefully considered. The use of radio buttons defines the number of possible choices available to the user, which may be acceptable for one project, but not for another.

Buttons

All buttons must be the Microsoft style of buttons.

In general, the default button will be the OK button, the Close button or the Yes button, but this will depend on the context of the dialog box that the button is associated with.

OK button:

Accepts and validates entered settings and values and closes the dialog. If the values have not been changed, then no action will be taken. The status bar will reflect the status. The user should only be queried, if the settings or values accepted will over–write data that CAN NOT be reproduced.

A greyed **OK** button indicates that settings selected by the user are not acceptable.

Close button:

Closes the current dialog box. Does not send or store anything and closes the dialog. The Close button is only used for dialogs that do not set or change any data.

Cancel button (Esc):

Cancel operation. Does not send or store anything and closes the dialog box.

A greyed **Cancel** button indicates that it is not possible to quit from this dialog box.

Yes button (ALT+Y or Y):

Replies Yes to a question asked of the user.

No button (ALT+N or N):

Replies No to a question asked of the user.

Help button (ALT+H):

Opens context sensitive help as F1–key does.

Reporting Status

The status bar will be used to report the present status to the user. When a feature is initiated, the status bar will be updated with a brief description of the function. The status bar will also be updated at key points in a time consuming function.

If an error is to be reported to the user, it will be displayed in the status bar as well as displayed in a common error dialog box. This will mean the user is not delayed from progressing on to the next operation unless an error occurs, in which case, the user will have to acknowledge the error by pressing the OK button.

NHE/K–5 & NHE/K–6 Specific Features

Menu Bar

The Service Software's menus adopts the menu structure specified by CLF.

Product

New command

Activation	Status Bar Text
Alt, P, N Ctrl+R	Rescan a new phone

This command scans a new product. When phone is found a product specific functionality module is loaded. If no phone or wrong phone/cellular type is detected, functionality is unloaded and user is informed.

This function is also started automatically when the application is started. The user can also specify a regular poll which enables the WinTesla application to scan the new phone periodically. If the phone is still the same, no changes are done. If the phone is changed (with same phone type only the serial number is changed), the phone will be initialized to a normal mode. If the phone is changed to a different phone type, the current dlls are unloaded and new ones are loaded for that phone.

The initialization routine checks the phone's cellular type (GSM/PCN), and if an unsupported phone is detected, the WinTesla application does not load the dlls.

If quick info view is open, the window will be automatically updated.

If phone identification view is open, the window will be automatically updated.

Open... command

Activation	Status Bar Text
Alt, P, O	Force load phone specific functionality

Enables the user to force load specific phone's WinTesla dll's.

Close command

Activation	Status Bar Text
Alt, P, C	Close loaded functionality

Closes loaded functionality and sends reset to phone if dlls are loaded by Open command.

Initialize command

Activation	Status Bar Text
Alt, P, I	–

Opens a submenu which contains the following options:

Normal Mode

Activation	Status Bar Text
Alt, P, I, N F5	Initializes phone to normal mode

When normal mode has been activated or program has been started, self–test results will be asked from MCU. If any fault was found in the tests, an error message is shown. If normal mode has been set successfully (no self test error has been found), and paging listening has been started, the used AFC value is requested from MS.

The Initialization routine checks the phone's cellular type (GSM/PCN) and if an unsupported phone is detected, the application unloads the dlls.

If phone identification view is open, the window will be automatically updated. Also if RF Information Window is open it will be updated to quick info view.

Local Mode

Activation	Status Bar Text
Alt, P, I, L Shift+F5	Initialises phone to local mode

Selection will change the MS state to *local*. When local mode is selected the phone is controlled to the local mode so that special actions can be made (for example RF tunings).

Faultlog

Activation	Status Bar Text
Alt, P, F	–

Opens a submenu which contains following options:

Activate Faultlog...

Activation	Status Bar Text
Alt, P, F, A F9	Activates faultlogging

Edit Faultlog...

Activation	Status Bar Text
Alt, P, F, E	Activates faultlog editing

Note! This documentation will be updated as soon as WinTesla integration is ready.

Exit command

Activation	Status Bar Text
Alt, P, X	Exit application
Alt + F4	

Double click the application's Control menu button:

This command ends the Service Software session.

Configure

Options... command

Activation	Status Bar Text
Alt, C, O	Edit Service Software options

The **Options** dialog box contains the following items:

Language drop down list.

Current password edit box:

New Password edit box:

Retype Password edit box:

User ID edit box.

M2BUS Com Port drop down list.

Automatic Rescan edit box.

Note! This documentation will be updated as soon as WinTesla integration is ready.

Directories... command

Activation	Status Bar Text
Alt, C, D	Edit directory settings

The **Directories** dialog box contains the following items:

ID Data edit box:

Logs edit box:

Fault log file(s) edit box:

Data Validation file(s) edit box:

Flash images edit box:

Blow failures edit box:

Note! This documentation will be updated as soon as WinTesla integration is ready.

Faultlog... command

Activation	Status Bar Text
Alt, C, F	Edit faultlog settings

The **Faultlog** dialog box contains the following items:

Fault log enabled/disabled radio buttons:

Allow Manual Entry enabled/disabled radio buttons:

Automatic fault log prompting enabled 1/Disabled 2 radio buttons:

Station identity edit box:

Country of Repair edit box:

Warranty period months edit box / drop down list:

Maximum Time to repair edit box:

Note! This documentation will be updated as soon as WinTesla integration is ready.

Tuning

The tuning menu offers functions for ME adjustments.

AFC... command

Activation	Status Bar Text
Alt, T, A	Open an AFC diagram dialog box

Starts AFC tuning.

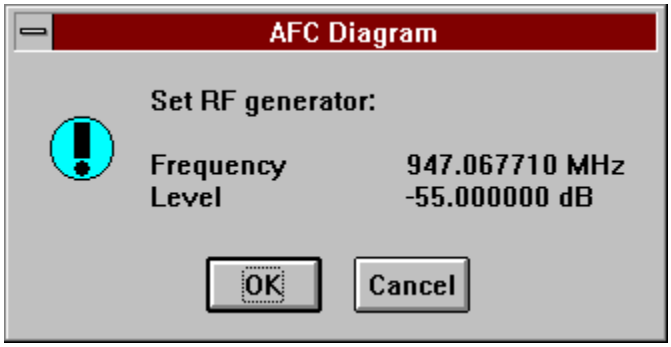
The following are automatically selected when this tuning function is activated:

Active Unit = RX

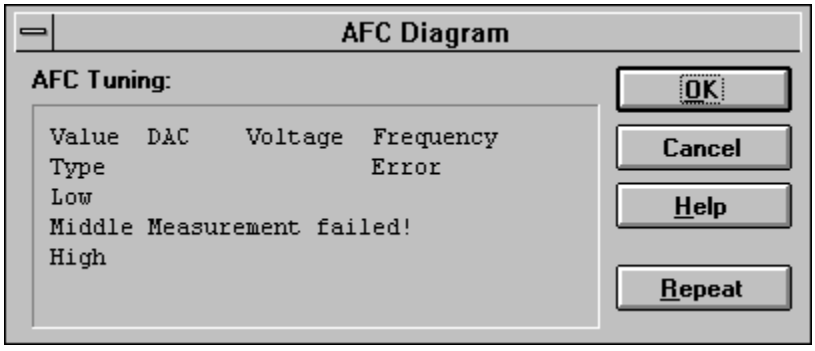
Operation mode = Continuous

Update RF Information window

Before tuning is stared, the user is requested to set signal generator to specified input level (read from .INI file).



The **AFC Diagram** dialog box will open when user accepts request:



The **AFC Diagram** dialog box contains the following items:

Repeat button (Alt+R):

The measurement can be started again by pressing Repeat button.

OK button (Alt+O):

The dialog box is closed, and tuning *is saved* to phone.

Cancel button (Esc):

Dialog is closed and tuning *is not saved* to phone.

The D/A converter range (DAC) is from +1023 to –1024 and voltage range is from 0.3 V to 3.9 V (voltage precision is 0.01 V).

The frequency error range is from –134 kHz to +134 kHz with the precision 0.1 kHz. The rounding is made to the closest value.

After exiting with the Cancel button, the following are reset to the values which were selected before this adjustment.

Active Unit

Operation mode

Update RF Information window

The AFC is also reset to its previous value after exiting with the Cancel button.

RSSI (AGC)... command

Activation	Status Bar Text
Alt, T, R	Open **RSSI Calibration** dialog box

Starts RSSI calibration.

The following are automatically selected when this tuning function is activated:

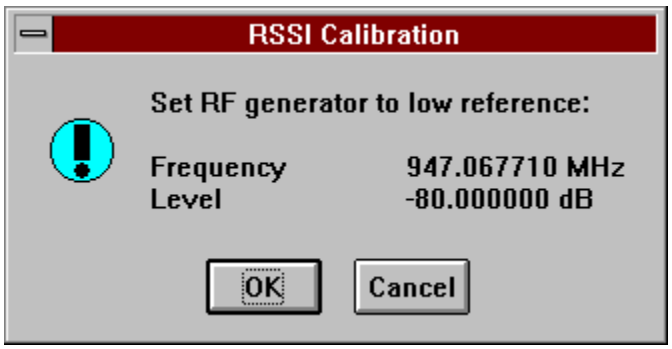
Active Unit = RX

Operation Mode = Continuous

Update RF Information window

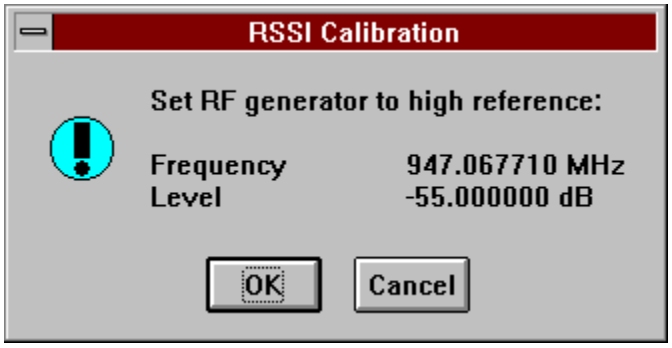
The measurement is started automatically when RSSI calibration is entered. The measurement is done in five steps:

1. The user is requested to set signal generator to low input level (read from .INI file).



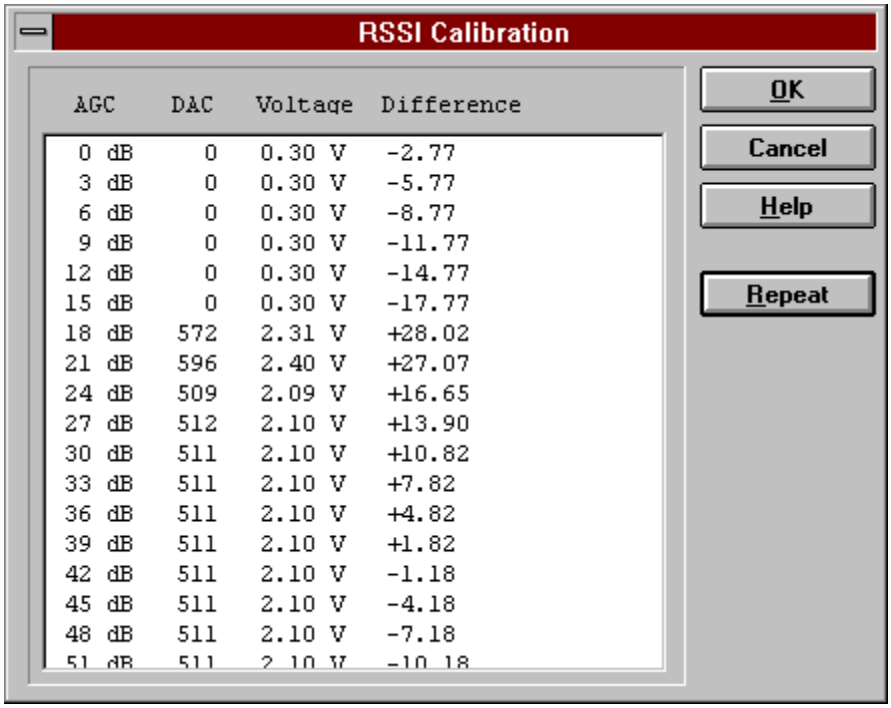
2. Measurement with low input level is executed.

3. The user is requested to set signal generator to high input level (read from .INI file).



4. Measurement with high input level is executed.

5. The **RSSI Calibration** dialog box will be updated when previous steps are done.



The **RSSI Calibration** dialog box contains the following items:

AGC List box (Alt+A):

Gain code DAC can have values from 0 to 1023 and voltage from 0.26 V to 3.86 V (voltage precision is 0.01 V). Note that the needed input signal level is also shown.

The difference column shows the difference between tuned DAC values and mean straight line calculated from part slopes in dBs (see /1/). This can be calculated when all measurement results have been received from phone.

Repeat button (Alt+R):

The measurement can be started again by pressing this button.

OK button (Alt+O):

The dialog box is closed, and tuning *is saved* to phone.

Cancel button (Esc):

The dialog box is closed and tuning *is not saved* to phone.

When calibration is ended, the DAC value check is made, and if it is unsuccessful, an error message is shown. The test checks if all DAC values are in the same order as AGC values in the table.

After exiting with the Cancel button, the following are reset to the values which were selected before this adjustment.

Active Unit

Operation Mode

Update RF Information window

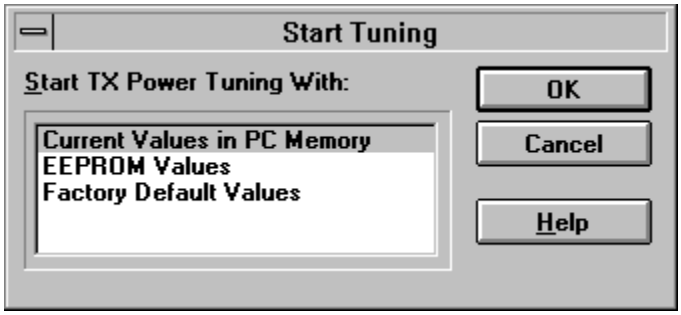
The exit and the use of AGC–control values is done the same way as exit from power level tuning and power coefficient use:

TX Power... command

Activation	Status Bar Text
Alt, T, X	Open **TX Power Tuning** dialog box

Starts TX power tuning.

The user is first requested to select with which values tuning is started in the **Start Tuning** dialog box.



The **Start Tuning** dialog box contains the following items:

Start Tuning With list box (Alt+S):

Current Values in PC memory

Tuning values are loaded from the program's internal memory.

EEPROM Values

Tuning values are loaded from ME's EEPROM.

Factory Default Values

Tuning values are loaded from ME's flash.

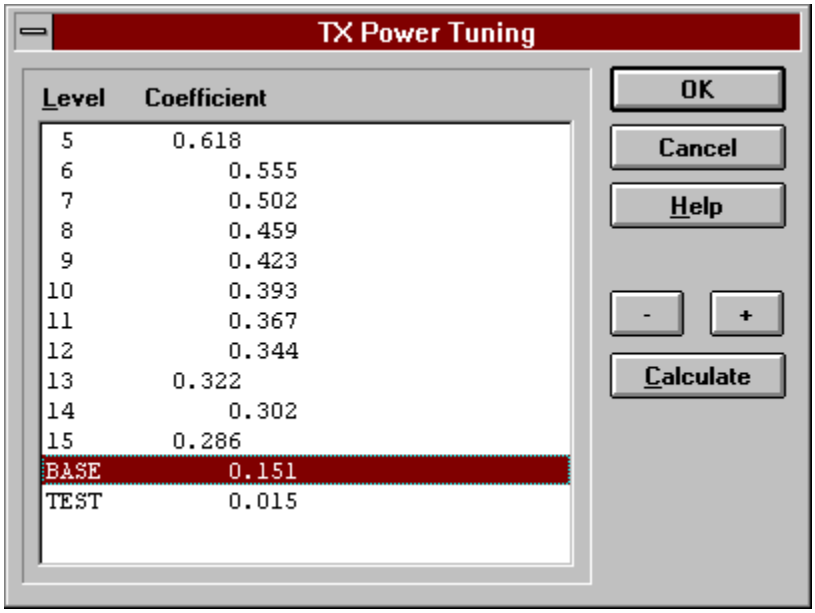
The following are automatically selected when this tuning function is activated:

– Active Unit = TX

– the BASE power level is selected

– Operation mode = Burst

The **TX Power Tuning** dialog box will be activated automatically after value selection.



The **TX Power Tuning** dialog box contains the following items:

Power Level & Coefficients list box (Alt+P):

The power is presented in GSM values (5..15) or PCN values (0...10). The base power is selected automatically when the dialog box is opened. The test value is reset to 0.035 when the program is started. The test value is not saved to the EEPROM. The test value can be changed during tuning as other power coefficients and the program remembers its value when tuning function is activated later again.

If there are more power levels in the phone than can fit into the window, the window is scrollable. When the phone is initialized, the program asks the number of power levels used in the phone.

Only four power coefficients (Base, biggest, third smallest and smallest) are needed to tune and the rest of them are calculated.

The tuning position is highlighted and can be tuned with +/– keys or left/right cursor keys.

NHE/K–6 Specific: If the application detects a phase 2 phone, the list box will also contain phase 2 power levels.

Calculate button (Alt+C):

The calculation is activated with this button. The power coefficients which are calculated from the tuned coefficients are displayed on the different columns than the others. All values can be tuned if needed.

+/– buttons (+/–):

The + and – buttons will cause power changing by 0.25dB steps (D/A converter control value ratio is 1.0292). When these keys are used, the coefficient value is updated on the tuning window.

OK button (Enter):

The dialog box is closed, and tuning *is saved* to phone.

Cancel button (Esc):

The dialog box is closed, and tuning *is not saved* to phone.

When selections are used, the power value checking is made and if it is unsuccessful, an error message is shown. The test checks that all power coefficients are in descending order (same order as power levels).

If the power tuning function is ended and EEPROM values are not received or EEPROM fault is noticed, an error message is shown.

When all power coefficients have such values that they don't cause any error messages, the dialog box will close. The last selected tuning power will be used after exit.

Because the stored power level range is larger than the number of used power levels, the unused levels should be set to nearest possible power level. (For example in GSM the levels 2–4 are not used, so they are set to same value as level 5).

When this tuning function is ended, the following is automatically selected:

Active Unit = RX

TX I/Q... command

Activation	Status Bar Text
Alt, T, Q	Open the **TX I/Q Tuning** dialog box

This function is used for tuning TX I and Q branch DC offset, amplitude difference and phase difference.

The function opens the same **Start Tuning** dialog box as with TX Power Tuning.

When this function is activated the following are automatically selected:

Active Unit = TX

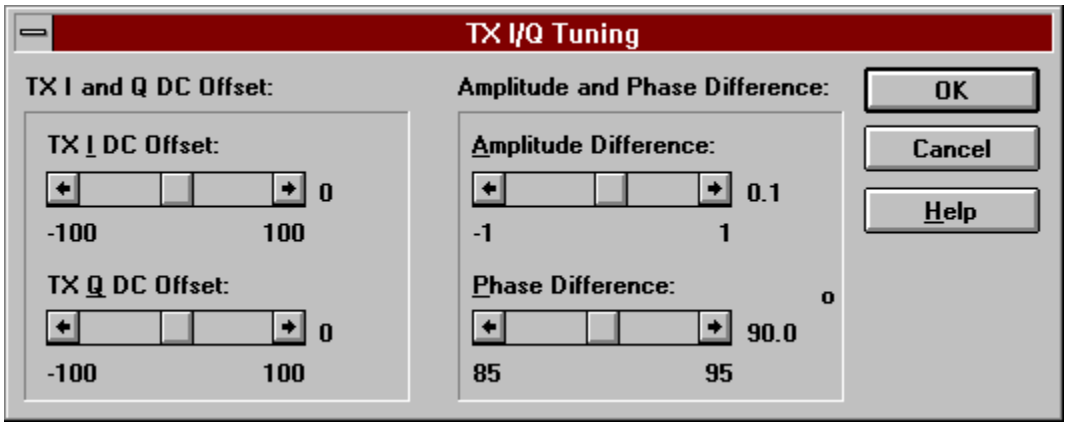
Operation Mode = Burst

TX Power Level = 10(GSM); 5(PCN)

If TX Data Type = RANDOM => TX Data Type = 1

Update RF Information window

The **TX I/Q Tuning** dialog box is opened.



The **TX I/Q Tuning** dialog box contains the following items:

Tune TX I DC Offset scroll bar (Alt+I):

The DC Offset is shown in percent (%) from the ± maximum value. 0% means that there is no DC. The value range is –100%...100%. The value is rounded to the nearest integer value.

Tune TX Q DC Offset scroll bar (Alt+Q):

The operation of this function is the same as one above, except with this selection the Q branch DC Offset is tuned. The value range is –100%...100%. The value is rounded to the nearest integer value.

Tune Amplitude Difference scroll bar (Alt+A):

When this selection is made, the user can increase or decrease the amplitude difference in 0.1 dB steps. The value range is –1...1.

Tune Phase Difference scroll bar (Alt+P):

When this selection is made, the user can increase or decrease the phase difference in 0.5° steps. The current phase difference is shown in the tuning window with numbers and bar figure. The value range is –85...95.

OK button (Enter):

The dialog box is closed, and tuning *is saved* to phone.

Cancel button (Esc):

The dialog box is closed, and tuning *is not saved* to phone.

After each value change, the new value is sent to the phone.

The following will be automatically selected when the TX I / Q tuning function is ended:

Active Unit = RX

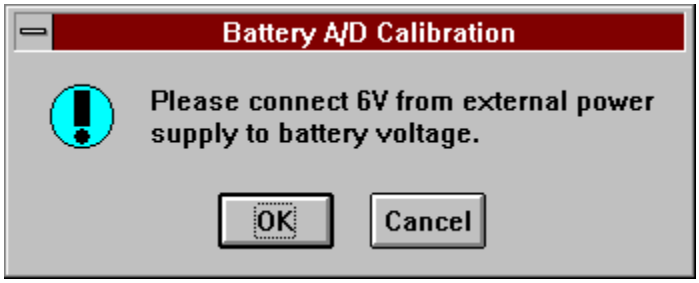
Update RF Information window

Battery A/D... command

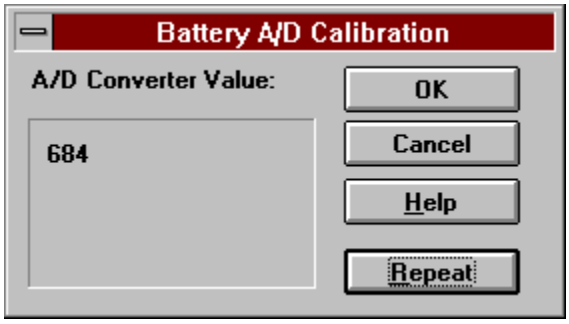
Activation	Status Bar Text
Alt, T, B	Calibrate battery voltage

This function is for battery a/d tuning.

Before **battery a/d** tuning is started, a voltage setting request is shown to the user:



When an external power is connected, and the user selects OK to continue, the application measures a/d converter and displays the **Battery A/D Calibration** dialog box.



The **Battery A/D Calibration** dialog box contains the following items:

Repeat button (Alt+R):

Makes measurement again.

OK button (Enter):

The dialog box is closed, and tuning *is saved* to phone.

Cancel button (Esc):

The dialog box is closed, and tuning *is not saved* to phone.

Charger A/D... command

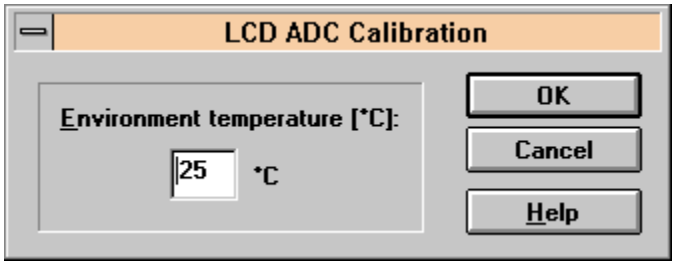
Activation	Status Bar Text
Alt, T, C	Calibrate charger voltage

Works in the same way as the previous Battery A/D calibration.

LCD A/D... command

Activation	Status Bar Text
Alt, T, T, D	Calibrate LCD temperature A/D

This function is for LCD ADC Calibration. Function opens the following dialog box.



The **LCD ADC Calibration** dialog box contains the following items:

Environment Temperature [°C]: edit box:

The user can change the environment temperature in the range 0 – 80°C.

OK button (ENTER):

Closes the dialog box and saves the measured value to EEPROM.

Cancel button (ESC):

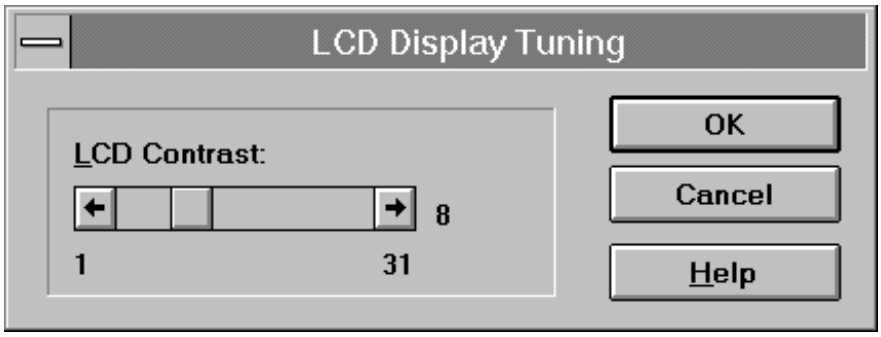
Closes the dialog box and *does not* do any calibrations.

LCD Display... command

Activation	Status Bar Text
Alt, T, T, L	Tune LCD display contrast

This function is used for quick LCD display contrast tuning.

The command opens the **LCD Display Tuning** dialog box, which contains tools for tuning.



The **LCD Display Tuning** dialog box contains the following items:

LCD Contrast scrollbar (ALT+L):

Enables user to tune display contrast between 1 and 31.

OK button (ENTER):

The dialog box is closed and tuning is saved to phone.

Cancel button (ESC):

The dialog box is closed and tuning *is not saved* to phone.

Testing

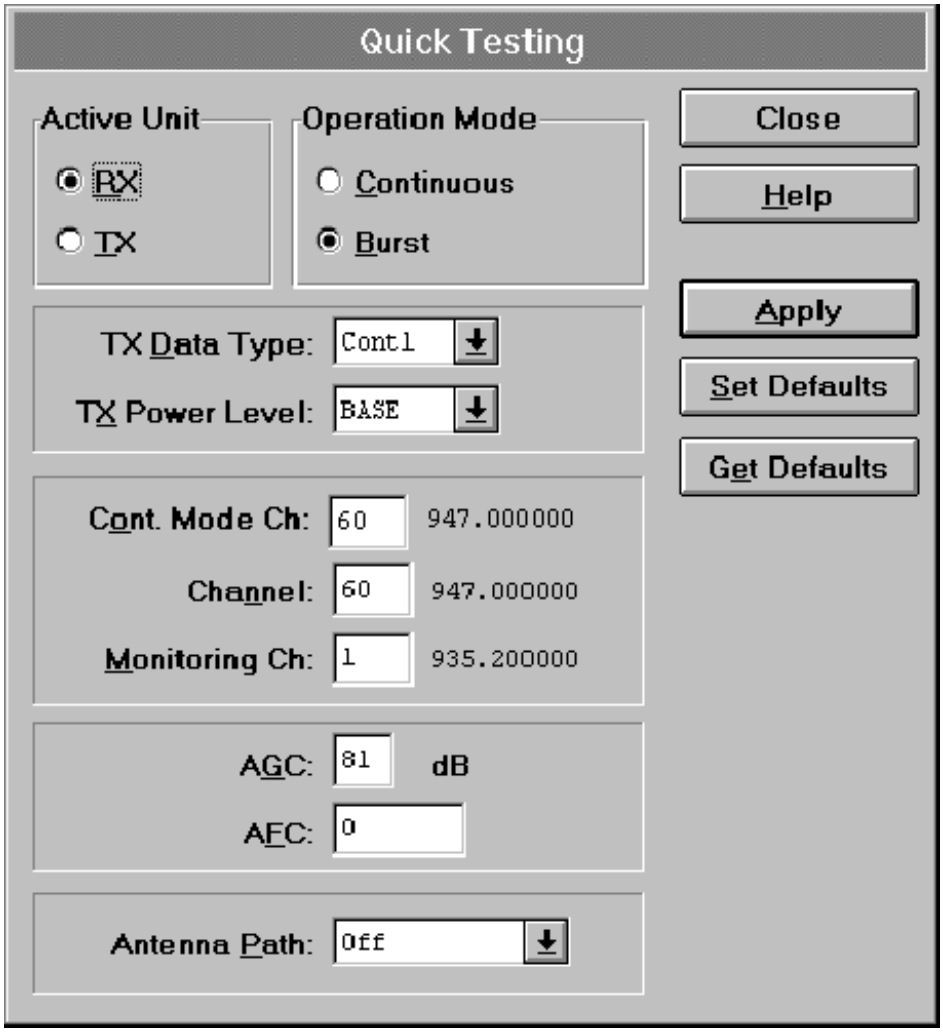
The **Testing** sub menu offers functions for ME testing.

Quick Testing (RF)... command

Activation	Status Bar Text
Alt, E, Q	Open the **Quick Testing** dialog box

This function is used for quick RF testing.

The command opens the **Quick Testing** dialog box, which contains data for testing and adjustments.



The **Quick Testing** dialog box contains the following items:

Active Unit group:

RX radio button (Alt+R):

When *RX* is selected, the next functions are made:

Data transmission is deactivated

TX power is deactivated

If operation mode is continuous,

– AGC is controlled

– RX continuous mode channel is activated

RF Information window is updated

The RX value is always given as default.

Note! The function is activated immediately, Apply is not needed.

TX radio button (Alt+T):

When *TX* is selected, the next functions are made:

Data transmission is activated

If operation mode is continuous, TX continuous mode channel is activated

If operation mode is burst, TX power is activated

RF Information window is updated

Note! the function is activated immediately, Apply is not needed.

Operation Mode group:

Continuous radio button (Alt+C):

When *continuous* selection is used,

Synthesiser is set to constant frequency

Synthesiser channel number is as given with Continuous Mode Channel selection

If Active Unit is TX, data (selected with TX Data Type) is sent

transmitter power is not connected

If Active Unit is RX, AGC is controlled

Note! The function is activated immediately, Apply is not needed.

Burst radio button (Alt+B):

When *burst* selection is used, the synthesiser is controlled by using GSM/PCN receiving/transmission/measuring synthesiser. Control sequence synthesiser channel numbers are as given with Channel/ Monitoring Channel selections if Active Unit is TX, data (selected with TX Data Type) is sent, and the TX power is connected

Note! The function is activated immediately, Apply is not needed.

TX Data Type drop list (Alt+D):

This list changes the transmission data type. The list consists of the following options: 0, 1, and Random. After Random, data selection 0 is used. If Operating Mode is *continuous*, TX Data Type Random causes different data sending than in burst mode.

TX Power Level edit box (Alt+T):

With this value it is possible to change the transmission power. The user can give the needed GSM/PCN power value (5..15/0...10) or select the test value, which is tuned with TX power tuning function. The test value is found at the end of the list.

TX Power has the value *OFF* and is disabled (*greyed*) when the active unit is RX or TX power as GSM or PCN value. When the TX power is tuned with test value (smallest value), the TX Power has the value *TEST*.

Channel edit box (Alt+H):

The user can enter here the channel number that is used for both transmission and receiving. The frequency of the selected channel is shown after selection.

Monitoring Channel edit box (Alt+M):

This field selects neighbouring monitoring channel. The frequency of the selected channel is shown after selection.

Continuous Mode Channel edit box (Alt+C):

To this edit box the user can type the continuous mode channel which may have all GSM channel numbers (1..124) or PCN channel numbers (512...885).

The used frequency depends on the Active Unit. If the Active Unit is RX, then RX frequency is used, else TX frequency. The frequency of the selected channel is shown after selection.

AGC edit box (Alt+G):

This selection allows user to edit the AGC absolute value (value from A/D converter). The AGC can have values from 0dB to 93dB in 3dB steps in GSM, and from 0dB to 81dB in PCN.

The AGC value is shown only when its value is controlled by the PC. When the Active Unit has value RX and Operation Mode is continuous, AGC is controlled by the PC except when next adjustment functions are activated:

RSSI Calibration

AFC Diagram

AFC edit box (Alt+F):

This selection allows the user to edit the AFC D/A converter value. The AFC can have values from –1024 to 1023.

The AFC value is the last measured AFC D/A converter value (11 bit 2–complement value is used with decimal digits). If the AFC results are not received, no text is shown. The AFC value is neither shown in the next situations i.e. when AFC is not controlled by PC:

AFC Diagram

Apply button (Alt+A):

Accepts entered values and validates them. After validation, the application sends corresponding messages to ME. Closes the dialog box, and updates Info Window.

Note: Active Unit and Operation mode command do not use the Apply button, as they are activated immediately.

Set Defaults button (ALT+S):

Sets current values as default Quick Test values.

Get Defaults button (ALT+E):

Gets default Quick Test values as current values.

NHE/K–6 Specific:

Antenna Path drop list (ALT+P)

Enables switching for antenna path between normal antenna and system cable.

The following are automatically done when the Quick testing function is ended:

Active Unit = RX

Update RF Information window

The next table shows the dialog box's properties in different situations:

ACTIVE UNIT = TX:

- TX Data Type: Updated
- AGC values: Greyed
- Monitoring Channel: Greyed
- OPERATION MODE = BURST:
  - TX Power Level: Updated
  - Continuous Mode Channel: Greyed
  - Channel: Updated
- OPERATION MODE = CONT.:
  - TX Power Level: OFF, Greyed
  - Continuous Mode Channel: Updated
  - Channel: Greyed

ACTIVE UNIT = RX:

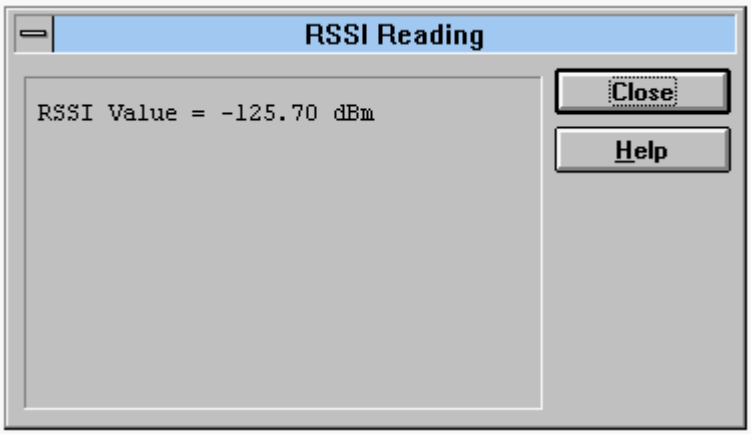
- TX Data Type: Greyed
- TX Power Level: OFF, Greyed
- OPERATION MODE = BURST:
  - AGC values: Greyed
  - Continuous Mode Channel: Greyed
  - Channel: Updated
  - Monitoring Channel: Updated
- OPERATION MODE = CONT:
  - AGC values: Updated
  - Continuous Mode Channel: Updated
  - Channel: Greyed
  - Monitoring Channel: Greyed

RSSI Reading... command

Activation	Status Bar Text
Alt, E, R	Open RSSI Reading dialog box

The command is used for reading RSSI values.

When the selection is made, the test result will be shown to the user in the **RSSI Reading** dialog box:

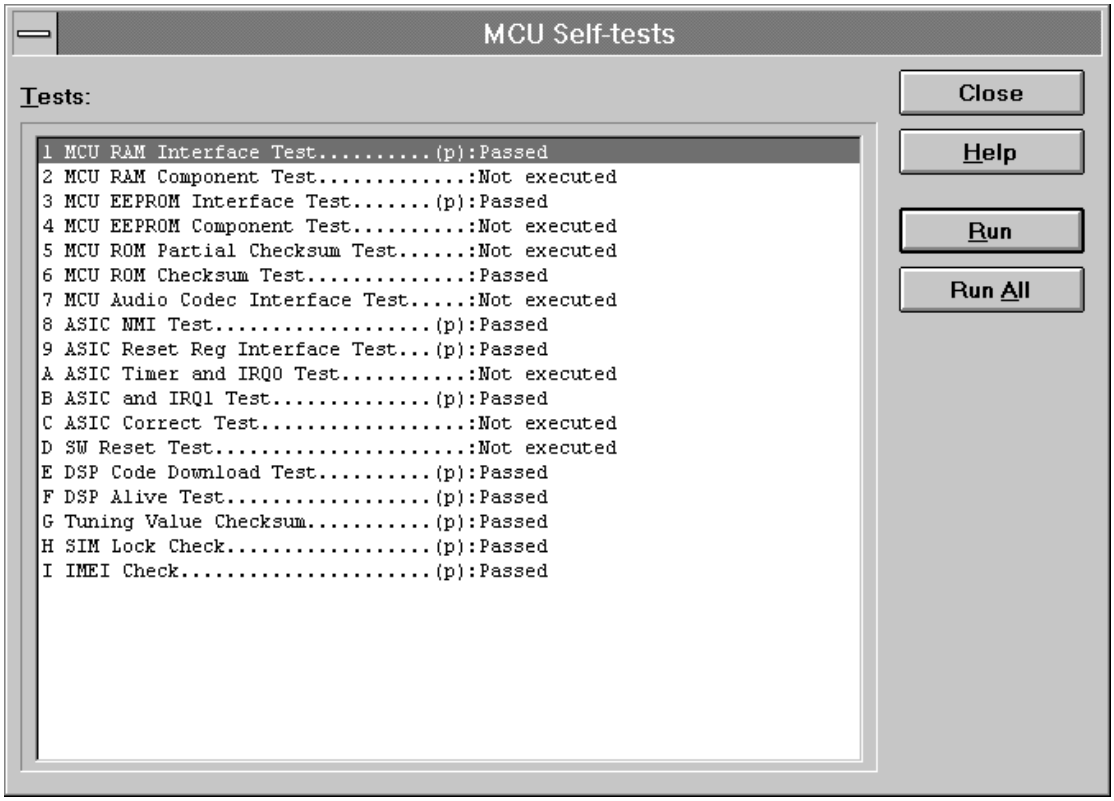


Self Tests... command

Activation	Status Bar Text
Alt, E, S	Open MCU Self–tests dialog box

The command is used for reading self test results and running self tests.

When the selection is made, the test result is read from ME. The test result will be shown to the user within the **MCU Self–test** dialog box.


MCU Self-tests
Tests:
1 MCU RAM Interface Test.....(p):Passed
2 MCU RAM Component Test.....:Not executed
3 MCU EEPROM Interface Test.....(p):Passed
4 MCU EEPROM Component Test.....:Not executed
5 MCU ROM Partial Checksum Test.....:Not executed
6 MCU ROM Checksum Test.....:Passed
7 MCU Audio Codec Interface Test.....:Not executed
8 ASIC NMI Test.....(p):Passed
9 ASIC Reset Reg Interface Test...(p):Passed
A ASIC Timer and IRQ0 Test.....:Not executed
B ASIC and IRQ1 Test.....(p):Passed
C ASIC Correct Test.....:Not executed
D SW Reset Test.....:Not executed
E DSP Code Download Test.....(p):Passed
F DSP Alive Test.....(p):Passed
G Tuning Value Checksum.....(p):Passed
H SIM Lock Check.....(p):Passed
I IMEI Check.....(p):Passed
Close
Help
Run
Run All

The **MCU Self–test** dialog box contains the following items:

Tests list box (Alt+T):

The field ”(p)” in the screen example means that the test is also run in power up.
The field “/s)” means that this test is selectable one.

Test states are updated according to results received from the phone. Possible test states will be one of the following:

Passed

Failed

No response

Not executed

RUNNING....

Run button (Alt+R):

The user can select desired test from list and hit **Run** button. When user selects test to be run, the text *RUNNING...* is shown in the test state field, and test is run. When results are received, the test state field is updated according to the result.

If no response was received in the defined time, a *error message box* will be shown and the test state is changed to *No response*.

Run All button (Alt+A):

The user can run all listed tests. The text *RUNNING...* is shown in the test state field, and test is run. When results are received, the test state field is updated according to the result. When the state field is updated, the application moves to the next test and repeats previous cycle.

Supported Self Tests

1 MCU RAM Interface Test.....:

2 MCU RAM Component Test.....:

3 MCU EEPROM Interface Test.....:

4 MCU EEPROM Component Test.....:

5 MCU ROM Partial Checksum Test...:

6 MCU ROM Checksum Test.....:

7 MCU Audio Codec Interface Test..:

8 ASIC NMI Test.....:

9 ASIC Reset Reg Interface Test...:

A ASIC Timer and IRQ0 Test.....:

B ASIC and IRQ1 Test.....:

C ASIC Correct Test.....:

D SW Reset Test.....:

E DSP Code Download Test.....:

F DSP Alive Test.....:

G Tuning Value Checksum.....:

H SIM Lock Check.....:

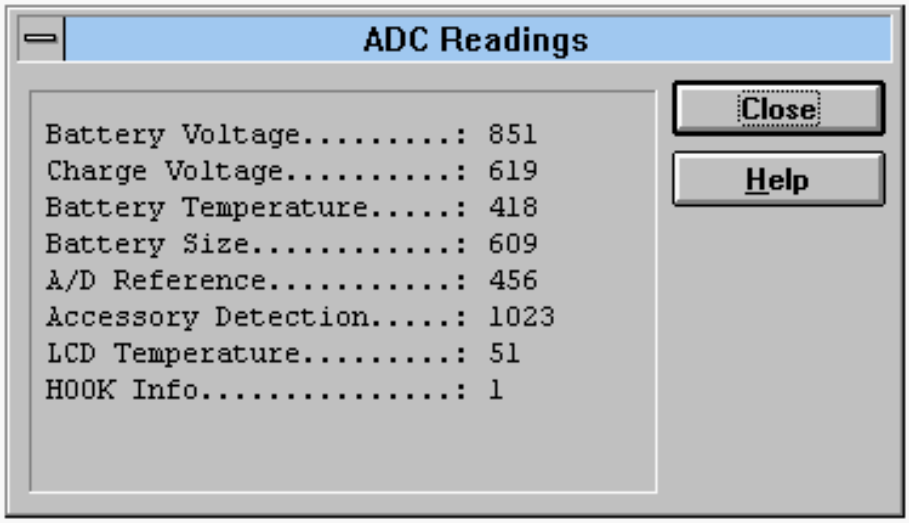
I IMEI Check.....:

ADC Readings... command

Activation	Status Bar Text
Alt, E, A	Open the **ADC Readings** dialog box

The command is used to read and show A/D values from phone.

The command opens the **ADC Readings** dialog box:



The **ADC Readings** dialog box has static text fields where measurements are updated to the window every one second.

A/D Readings

The following a/d readings are measured:

Battery Voltage . . . . . :

Charge Voltage . . . . . :

Battery Temperature . . . . . :

Battery Size . . . . . :

A/D Reference. . . . . :

Accessory Detection. . . . . .:

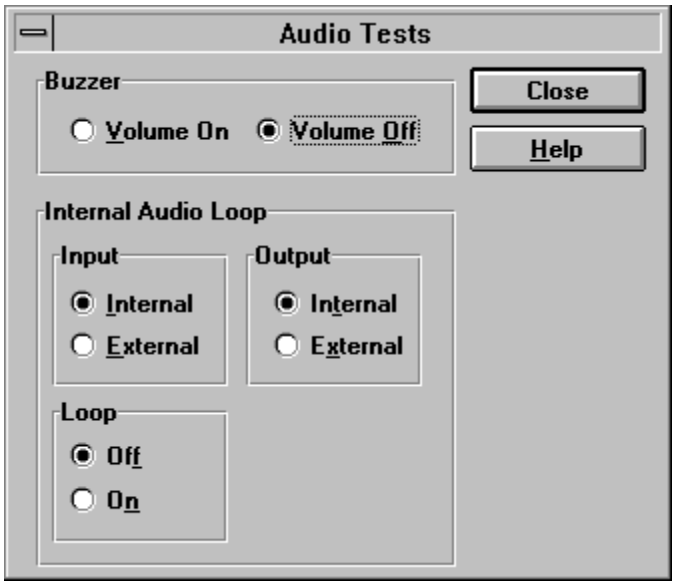
LCD Temperature . . . . . :

Hook Info . . . . . :

Audio... command

Activation	Status Bar Text
Alt, E, U	Open Audio Tests dialog box

The command is used for making audio tests in the **Audio Tests** dialog box.



The **Audio Tests** dialog box contains following items:

Buzzer group:

The next two different values can be selected for Buzzer volume:

Volume On radio button (ALT+V):

Turns buzzer on.

Volume Off radio button (ALT+O):

Turns buzzer off.

Internal Audio Loop group:

Input group:

The next two different values can be selected for input:

Internal radio button (Alt+I):

Switches to internal input.

External radio button (Alt+I):

Switches to external input.

Output group:

The next two different values can be selected for output:

Internal radio button (Alt+T):

Switches to internal output.

External radio button (Alt+X):

Switches to external output.

Loop group:

The next two different values can be selected for loop:

Off radio button (Alt+F):

Turns audio loop off.

On radio button (Alt+N):

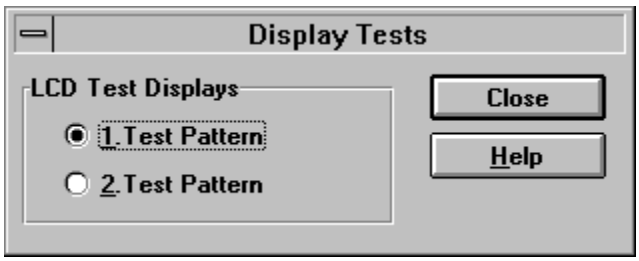
Turns audio loop on.

When the dialog box is closed, the Buzzer Volume is always switched off. The internal audio loop is also turned off.

Display... command

Activation	Status Bar Text
Alt, E, D	Open Display Tests dialog box

This command is used for making display tests in the **Display Tests** dialog box.



The **Display Tests** dialog box contains the following items:

1. Test Pattern radio button (Alt+1):

In test display 1 half of the indicators are displayed, and the display is filled with chessboard letters.

2. Test Pattern radio button (Alt+2):

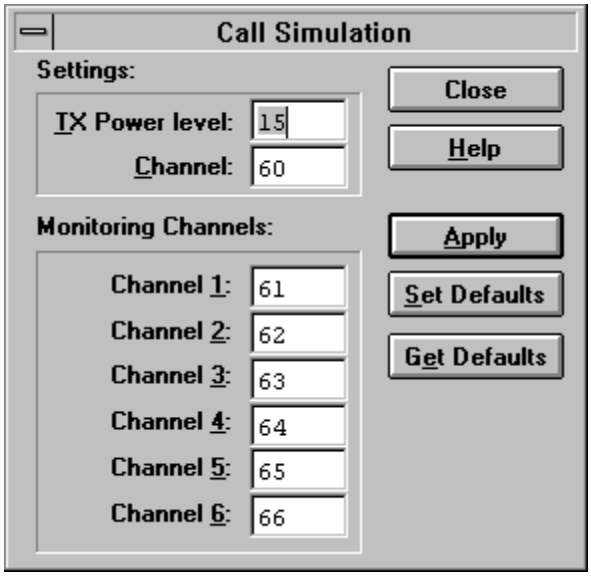
In test display 2 the remainder (from test 1) of the indicators are displayed, and the display is filled with inverse chessboard letters.

When the dialog box is closed, the phone LCD display is cleared.

Call Simulation.. command

Activation	Status Bar Text
Alt, E, C	Open Call Simulation dialog box

The command is used for making call simulation. The function opens the **Call Simulation** dialog box.



The **Call Simulation** dialog box contains the following items:

TX Power Level edit box (Alt+T):

All power levels can be selected. This updates same parameter as **TX Power Level** in the **RF–Controls** dialog box. Note that TEST value cannot be selected. If TEST value was in use when Call simulation menu selected, power level is changed to smallest value.

Channel edit box (Alt+C):

This tells the normal operating RF channel number. Normal GSM/PCN channel numbers can be selected. Same channel is used both for transmission and receiving. This updates same parameter as **Channel** in the **RF–Controls** dialog box.

Monitoring Channels group:

Channel 1,2,3,4,5,6 edit box (Alt+1,2,...):

Channels for monitoring are specified with these six selections. All GSM/PCN channel numbers can be used. If more than one selection has same number, the monitoring channel list (neighbour list) will have less than 6 selected channels. The minimum number of monitoring channels is one (all channels have same value). The monitoring channel can also have same value as normal operating channel.

The first monitoring channel updates the same parameters as **Monitoring Channel** in the **RF–Controls** dialog box.

Apply button (Alt+A):

Validates and sends entered data to ME.

Set Defaults button (ALT+S):

Sets current values as default Call Simulation values.

Get Defaults button (ALT+E):

Gets default Call Simulation values as current values.

Noise Sensitivity... command

Activation	Status Bar Text
Alt, E, N	Opens Noise Sensitivity dialog box

The command is used for noise sensitivity measurement.

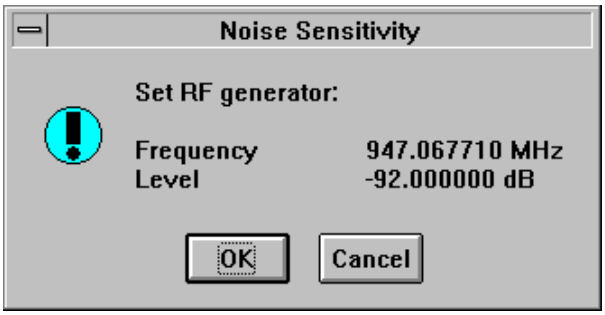
The following are automatically selected when this tuning function is activated:

– Active Unit = RX

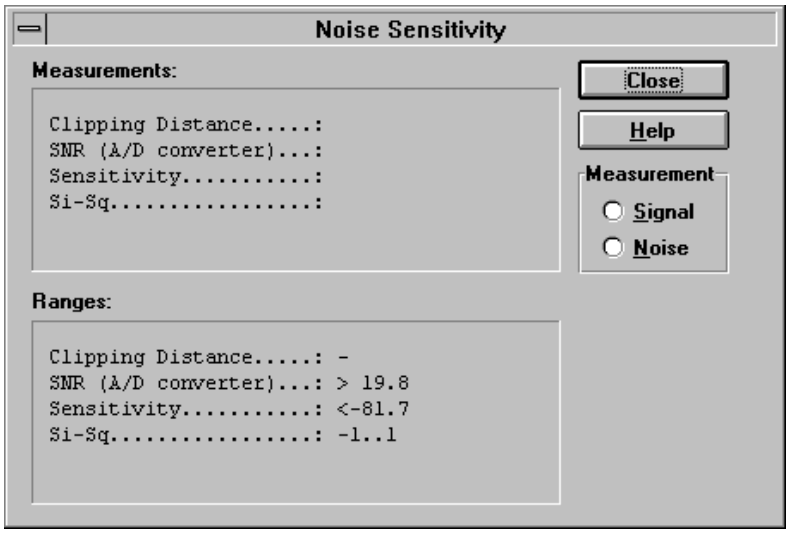
– Operation mode = Continuous

– AGC = 81 dB

Function opens next a **Noise Sensitivity** dialog box.



The application then opens the **Noise Sensitivity** dialog box:



The **Noise Sensitivity** dialog box contains the following items:

Measurements group:

Clipping distance is the difference to the signal clipping value. SNR is measured in the AD converter.

Clipping distance = clipping level (66) – signal value + comp_factor1
SNR = signal value – noise value + comp_factor1

Sensitivity = –92 dBm + 8 dB + comp_factor2 – SNR (for GSM)

Sensitivity = –90 dBm + 8 dB + comp_factor2 – SNR (for PCN)

The last value on the display is signal power difference between I and Q branch. The numbers are shown in 0.1dB accuracy. The error messages, ”OUT OF RANGE”, are shown only if the SNR and/or amplitude difference values are not acceptable (SNR <= 18 dB + comp_factor2 – 0.5 dB(= accuracy) ; Sensitivity >= –100 dBm + 0.5 dB ; |Si – Sq| > 1 dB).

Signal/Noise button (Alt+S/Alt+N):

When the buttons are pressed, the RX I and Q burst data is asked, text ”SIGNAL MEASURING...” or ”NOISE MEASURING...” will apear in the measurement group window. The power level value should be –92 dBm during signal measurement.

When signal data is received, distance to clipping signal level is shown as dBs on the display. When either signal or noise measurement results are received ”MEASURING” text is removed and measurements are updated to screen. When both measurements (signal and noise) are done at least once, the signal to noise relation and difference are also shown on the display.

After exiting the dialog box, the following are set to the values which were selected before this adjustment.

– Active Unit

– Operation mode

– AGC value

Compensation factors:

comp_factor1 = 4.64 dB (Compensation factor for 67.71 kHz signal, because ASIC filter attenuates 67.71 kHz signal 4.64 dB)

comp_factor2 = 2.27 dB (Compensation factor for real and calculated noise bandwidth difference. Real noise bandwidth is 80 kHz and calculated bandwidth is 135 kHz)

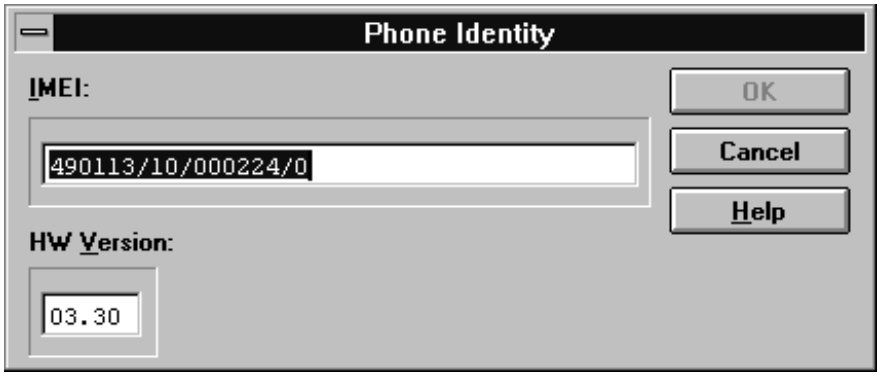
Software

The settings sub menu offers functions for Mobile Equipment mode and memory settings.

Phone Identity... command

Activation	Status Bar Text
Alt, S, I	Opens the **Phone Identity** dialog box for editing

The function is used to edit phone identity. The function opens the **Phone Identity** dialog box:



The **Phone Identity** dialog box contains the following items:

IMEI edit box (Alt+I):

Field where the user can enter current IMEI value. Field can contain up to 40 digits.

HW Version edit box (Alt+V):

Field where user can enter current HW version. Field can contain four digits and one dot. Dot is not sent to ME.

OK button (Enter):

Checks if some values are changed and if IMEI was modified, asks for confirmation. After confirmation, it writes values to phone.

Cancel button (Esc):

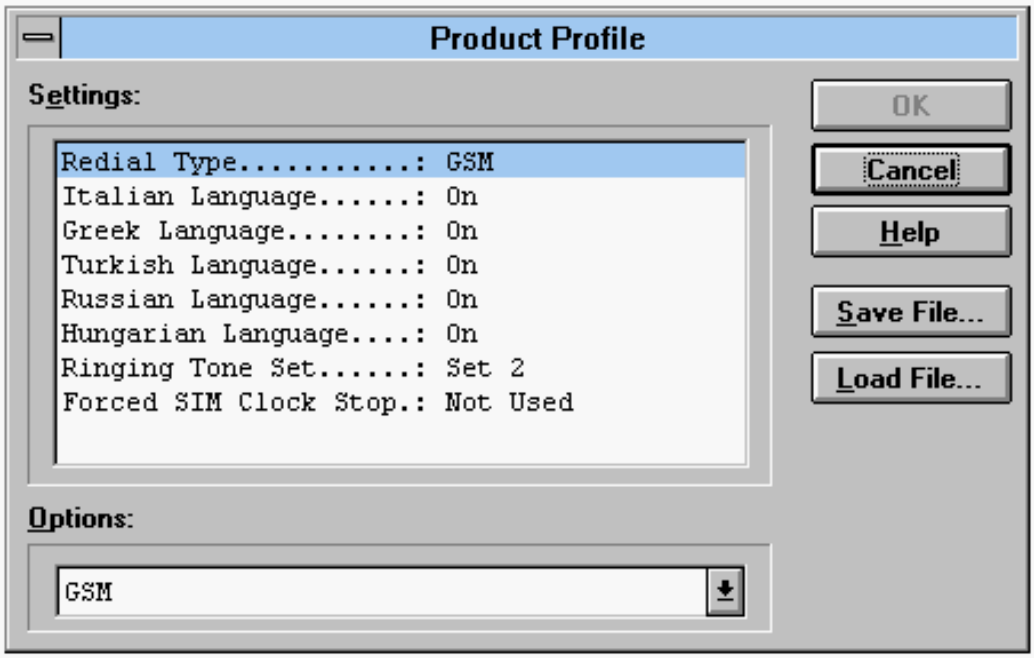
Cancels all edits and does not save values to phone.

Product Profile... command

Activation	Status Bar Text
Alt, S, P	Open **Product Profile** Settings dialog box

The function is used for making product profile settings.

When the command is activated, the product profile information is read from the EEPROM and **the Product Profile** dialog box is opened.



The **Product Profile** dialog box contains the following items:

Settings list box (Alt+E):

A list where the user can select desired setting.

The user can toggle settings with following **Options** drop list, or by double clicking the desired setting in list box.

Options drop list (Alt+O):

List allows user to set options to each setting listed in the **Settings** list box. Possible options per setting are:

OK button (ENTER)

Selections are accepted and saved to EEPROM.

Cancel button (ESC)

Selections are ignored and control is returned back to main menu.

Save File... button

Allows the user to save settings to file. Opens a standard windows **File Save** dialog box.

Load File... button

Allows the user to load the settings from a file. Opens a standard windows **File Open** dialog box.

NHE/K–5 Product Profile Settings

The following settings are available:

Russian Language	On/Off
Italian Language	On/Off
Greek Language	On/Off
Turkish Language	On/Off
Keypad Type	Nokia Design 1/2/OEM
Redial Type	GSM, Non GSM
CO SMS Appearance	Normal/Enhanced
Service Numbers	Available/Not Available
Forced SIM Clock stop	On/Off

See the NHE–5/NHK–5 Product Profile Specification for more info.

Note! When forced SIM Clock Stop is switched ON, stand–by time is increased consideraby

NHE/K–6 Product Profile Settings

The following settings are available:

Redial Type	GSM, Non GSM
Italian Language	On/Off
Greek Language	On/Off
Turkish Language	On/Off
Russian Language	On/Off
Hungarian Language	On/Off
Ringing Tone Set	Default Set/Set 1
Forced SIM Clock stop	On/Off

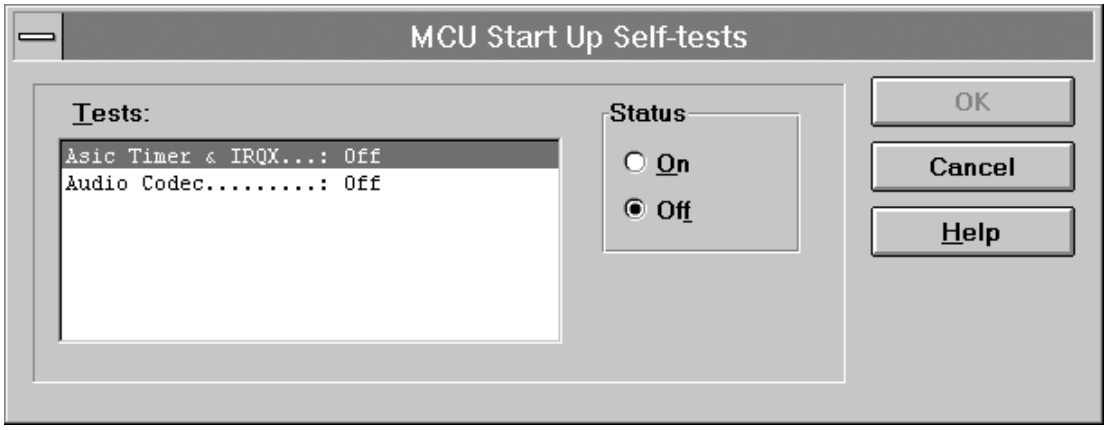
See the NHE–6/NHK–6 Product Profile Specification for more info.

Note! When forced SIM Clock Stop is switched ON, stand–by time is increased consideraby

Start Up Self–tests... command

Activation	Status Bar Text
Alt, S, S	Open **MCU Start Up Self–tests** dialog box

The function is used for changing the state of the EEPROM selectable tests in the **MCU Start Up Self–tests** dialog box.



The **MCU Start Up Self–tests** dialog box contains the following items:

Tests list box (Alt+T):

When dialog box is opened, the previous values will be read from the MCU EEPROM and shown on the list box.

Status group:

When radio button **On** is selected, the test will be run every time when automatic start up self–tests are activated (e.g. in power up).

OK button (Enter)

Selections are accepted and saved to EEPROM. A power up routine is made to phone.

Cancel button (Esc)

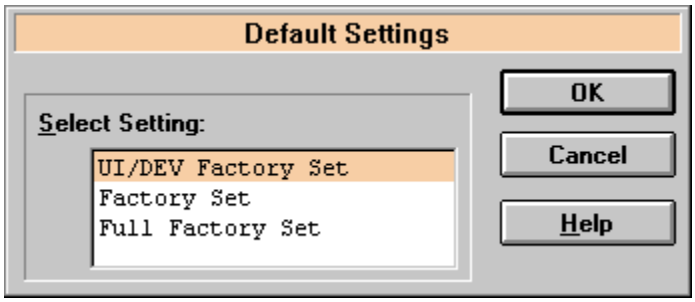
Selections are ignored and control is returned back to main menu.

Set Default Values... command

Activation	Status Bar Text
Alt, S, V	Set factory default values

The command is used for resetting default values to phone's EEPROM.

After selection, the following Default Settings dialog box is opened:



The **Default Settings** dialog box contains the following items:

Select Settings list box (Alt+S):

Enables user to select set to be reset: UI/DEV Factory Set, Factory Set or Full Factory Set.

OK button (Enter)

Closes the dialog box and writes the selected set to the EEPROM of the phone.

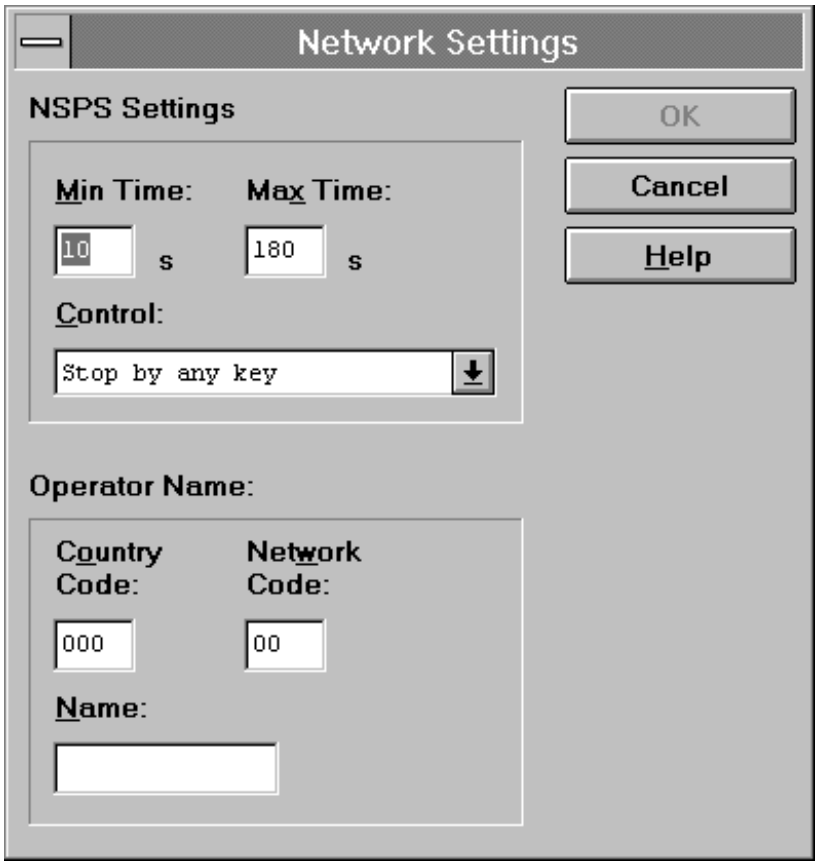
Cancel button (Esc)

Closes the dialog box and *does not* write settings to the phone.

Network Settings... command

Activation	Status Bar Text
Alt, S, N	Open **Network Settings** dialog box

After selection the following **Network Settings** dialog is opened:



The **Network Settings** dialog contains the following items:

NSPS Settings group:

Min Time edit box (ALT+M):

Minimum time for NSPS.

Max Time edit box (ALT+X):

Maximum time for NSPS.

Control drop list (ALT+C):

NSPS Control values:

– Stop by send key

– Stop by any key

– No key control

– NSPS not supported

Custom Operator Name group:

Country Code:

Specified country code

Network Code:

Specified network code

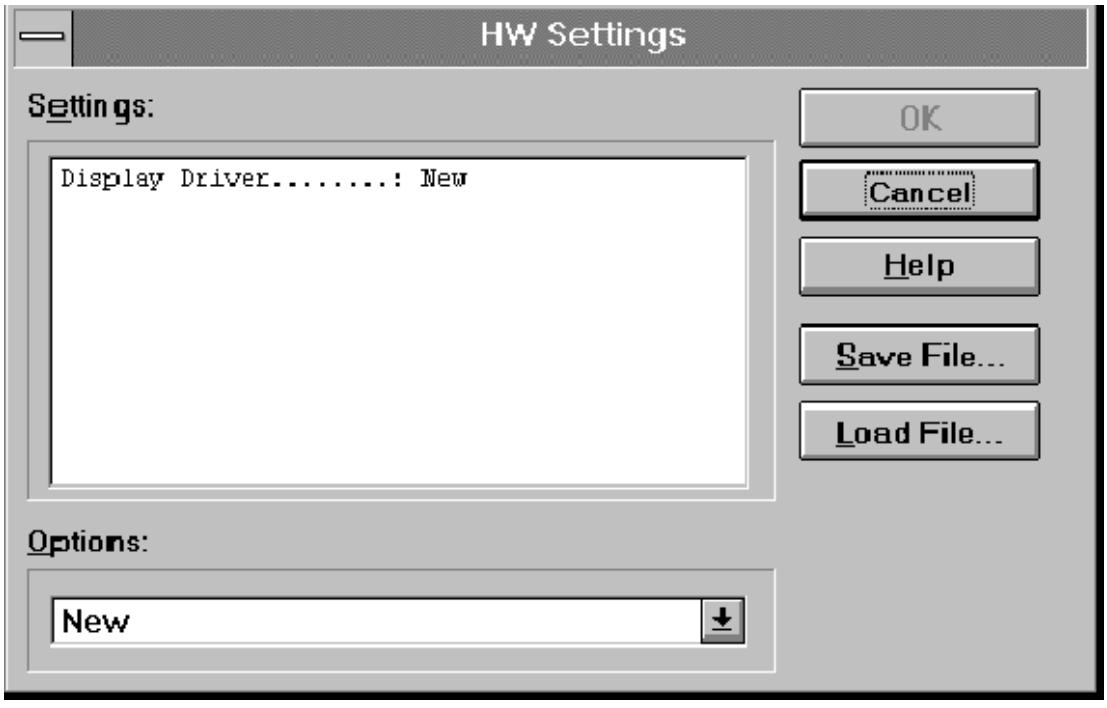
Name:

Name of the operator matching with country and network code. Length for operator name is 8 characters for NHE/K–5, and 10 characters for NHE/K–6.

HW Settings... command

Activation	Status Bar Text
Alt, S, H	Opens the **HW Settings** dialog box.

This command is used for toggling HW settings. The function opens the following **HW Settings** dialog box.



The **HW Settings** dialog box contains the following items:

Settings text area (ALT+E):

Displays current HW Settings and their state.

Options drop down list (ALT+O):

Enables user to toggle settings state.

Save File... button (ALT+S):

Opens the default Windows **File Save As** dialog box and asks as filename where to save HW Settings values.

Load File... button (ALT+L):

Opens the default Windows **File Open** dialog box and asks a file-name where from to load HW Settings values.

OK button (ENTER):

Closes the dialog box and saves the HW Settings to the phone.

Cancel button (ESC):

Closes the dialog box and *does not* save the settings to the phone.

NHE/K–5 Settings:

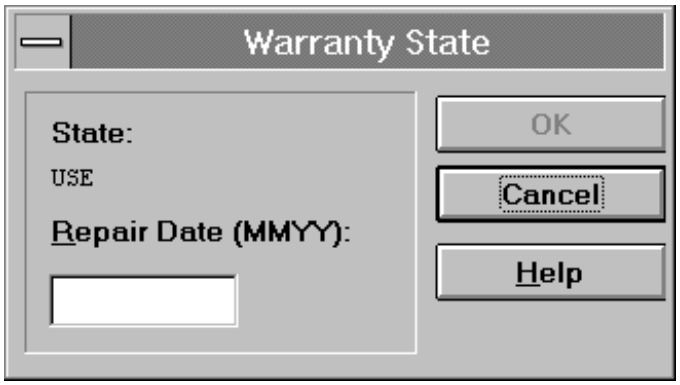
The following settings are available:

Display Driver . . . . . : New/Old

Warranty State... command

Activation	Status Bar Text
Alt, S, W	Opens the **Warranty State** dialog box.

This command is used for setting the Phone's Warranty State. The function opens the following **Warranty State** dialog box.



The Warranty State dialog box contains the following items:

State: static text:

USE

For normal phones.

DEFECTIVE

For phones which are being swapped. Warranty and other information is transferred to the working phone.

EXCHANGE

For phones which are already repaired from DEFECTIVE ones.

Repair Date edit box (Alt+R):

Format is MMYY (Where MM is month and YY two last digits of the year). The date is read from PC's clock. This is enabled only if state is DEFECTIVE.

OK button (ENTER):

Closes the dialog box, and saves the Warranty State to the phone. This button should be enabled only when phone is DEFECTIVE and repair date is entered.

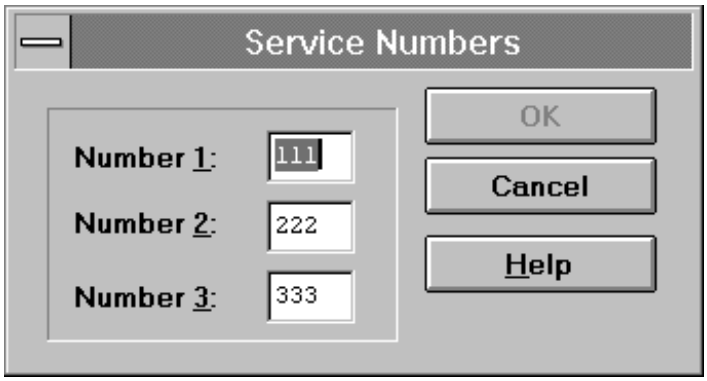
Cancel button (ESC):

Closes the dialog box, and does not save the Warranty State to the phone.

Service Numbers... command

Activation	Status Bar Text
Alt, S, B	Opens the **Service Numbers** dialog box.

This command is used for setting the phone's Service Numbers. This feature is available only in few countries. The function opens the following **Service Numbers** dialog box.



The **Service Numbers** dialog box contains the following items:

Number 1,2,3 edit fields:

Contains Service Numbers which can be called by pressing 1,2 and 3 numbers in keypad for prolonged time period. Service numbers are 3 digits long.

OK button (ENTER):

Closes the dialog box, and saves the numbers to the phone.

Cancel button (ESC):

Closes the dialog box, and *does not* save the numbers to the phone.

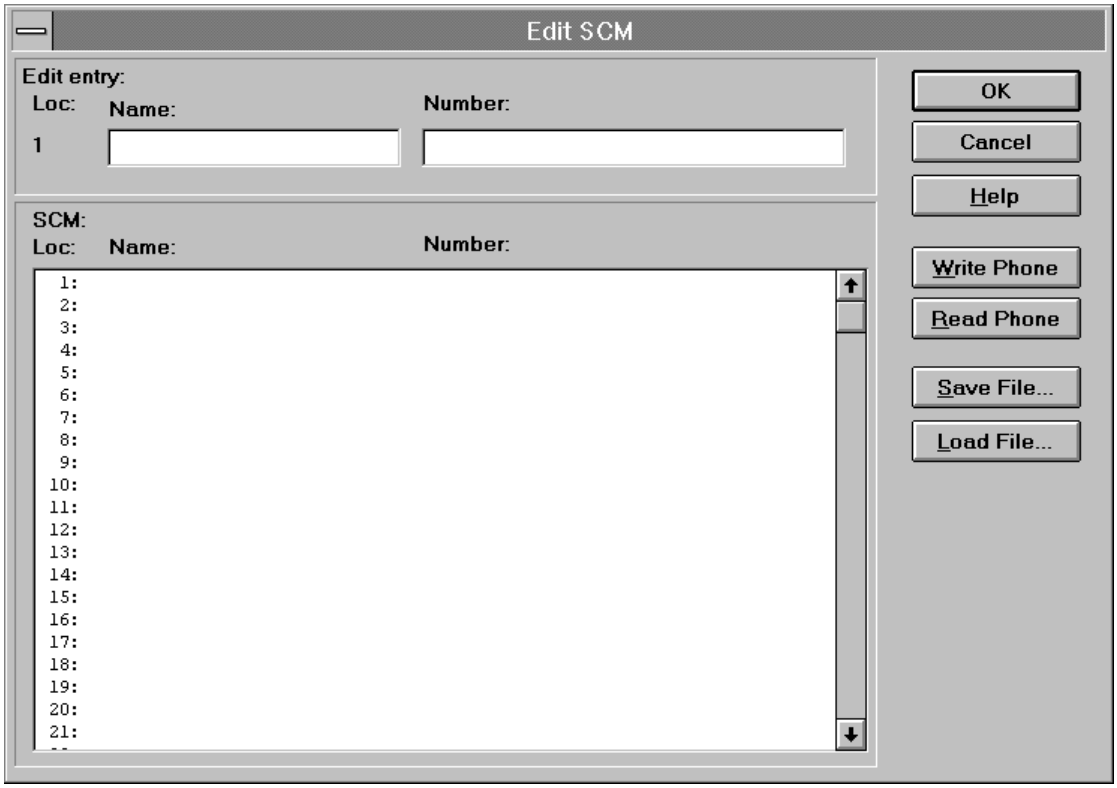
Dealer

The dealer sub menu offers functions for Mobile Equipment settings for dealers.

Short Code Memory... command

Activation	Status Bar Text
Alt, D, C	Opens the **Edit SCM** dialog box.

This command is used for reading, storing and modifying the SCM values. The function opens the following **Edit SCM** dialog box:



The **Edit SCM** dialog box contains the following items:

Loc static text:

Displays current location.

Name edit box (ALT+A):

Edit the Name.

Number edit box (ALT+N):

Edit the number.

SCM list box (ALT+C):

List for available names and numbers.

Write Phone... button (ALT+W):

Write SCM values to phone and checks the validity of names and numbers.

Read Phone... button (ALT+R):

Read SCM values from phone.

Save File... button (ALT+S):

Opens a default Windows **File Save As** dialog box, and asks for a filename where to save SCM values.

Load File... button (ALT+L):

Opens a default Windows **File Open** dialog and asks for a filename where from to load SCM values. Checks the validity of names and numbers.

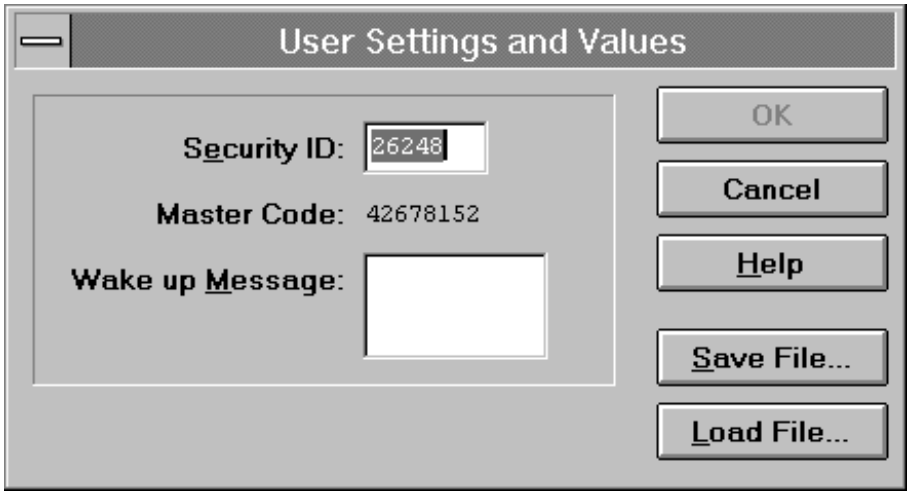
User Settings... command

Activation	Status Bar Text
Alt, D, U	Open **User Settings and Values** dialog box

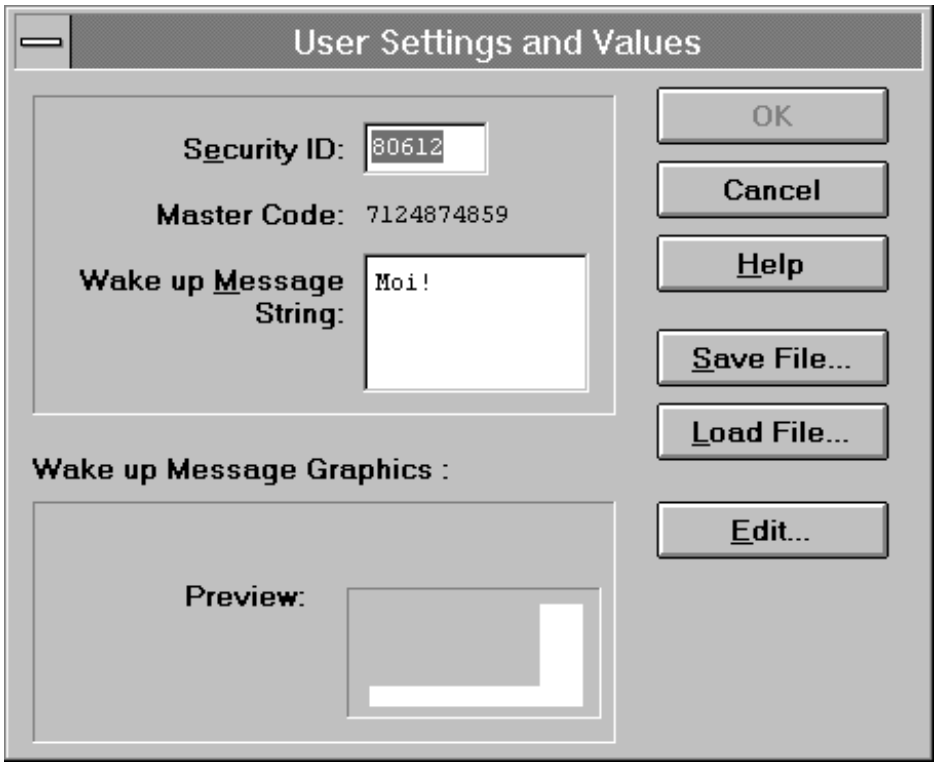
This command is used to read, store, and modify the user settings and values.

After menu selection, the program responds with a *query* dialog box: “Read user settings from phone?”. If user answers **Yes**, all needed user settings will be read from the ME, including menu settings. If a reading error happens, an *error* dialog box is shown. If reading is successful, the **User Settings and Values** dialog box is opened:

For NHE/K–5:



For NHE/K–6:



The **User Settings and Values** dialog box contains the following items:

Security ID edit box (Alt+E):

Edit the security code which is saved to the ME memory together with other user settings and values. Only digits are accepted for Security code. Length must be 5 digits.

Master Code static:

Code is 10 digits length and it is read only.

Wake up Message edit box (Alt+M):

Edit Wake up message. The wake up message name can have up to 16 characters.

Save File... button (Alt+S):

Opens a default Windows **File Save As** dialog box and asks filename where to save user settings and values.

Load File... button (Alt+L):

Opens a default Windows **File Open** dialog box and asks filename where from load user settings and values.

For NHE/K–6:

Preview image:

This image area shows the current wake up message graphics bitmap.

Edit button (ALT+E):

The user can launch the MS Windows Paint Brush application with current bmp file and edit it.

Data entered in the dialog box is checked for validity before it is sent to the phone. If the application finds wrong characters from the Wake up message, the application will inform the user, and request correction. The information window is shown during writing. The window tells how much time it will approximately take to write values.

When all values are sent and responses received, waiting window is removed and **User Settings and Values** is back in control. The waiting state can be broken with **Cancel** (Esc) button. If writing to the ME is broken, only part of the values in the ME may be changed.

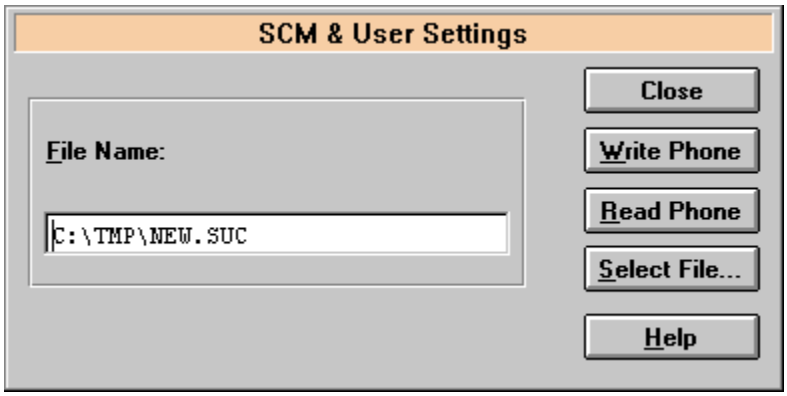
Both save file and load file function has default name which is previously used name. For instance if user data was saved to file USERA.USR and read function is activated the default value is USERA.USR.

SCM & User Settings... command

Activation	Status Bar Text
Alt, D, M	Open SCM & User Setttings dialog box.

This command is used to get SCM and user settings from phone to file and vice versa. When settings are read from the phone, all user settings are read from the phone and saved to file, in NHE/K–6 phones the graphical wake up message and SCM are also saved. When settings are written to the phone, all user settings except master code are loaded from file, in NHE/K–6 phones graphical wake up message and SCM are also loaded.

When data is written to or read from the phone, a waiting dialog box is shown.



The **SCM & User Setttings** dialog box contains the following items:

File Name edit box (ALT+F):

The user can edit the file name or select another file with the Open File dialog box. When the dialog box is opened, it contains the name of the previously saved or loaded file. Note that for NHE/K–6 phones the graphical wake up message is saved in its own file. If for example other settings iare saved to the file **c:\tmp\default.suc**, then the grapical wake up message is saved to file **c:\tmp\default.bmp**.

Close... button (ESC):

Closes the dialog box.

Write Phone... button (ALT+W):

Loads settings from file and writes them to phone.

Read Phone... button (ALT+R):

Reads settings from phone and writes them to file.

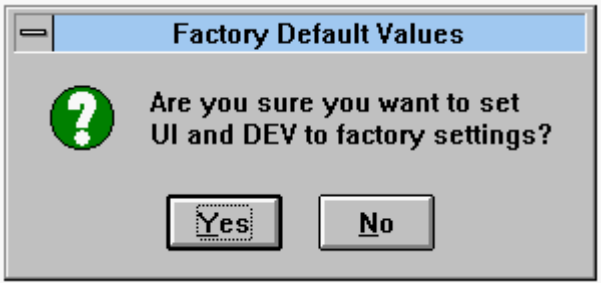
Select File... button (ALT+S):

Opens the Open File dialog box, with which the user can select the file that contains the data to be loaded to ME, or the file to which data is saved from ME. If the user selects OK button, the name of the selected file is copied to the File Name edit field.

Set UI/DEV Default Values... command

Activation	Status Bar Text
Alt, D, V	Reset phone to UI and DEV factory settings

After selection, the application asks for confirmation: “Are you sure you want to reset UI and DEV to factory settings?”. If Yes is answered, default settings are reset to the phone.

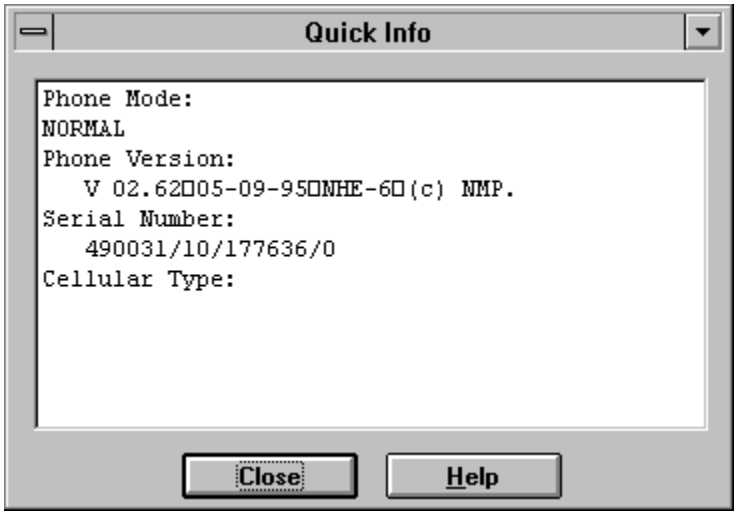


View

Quick/RF Info... command

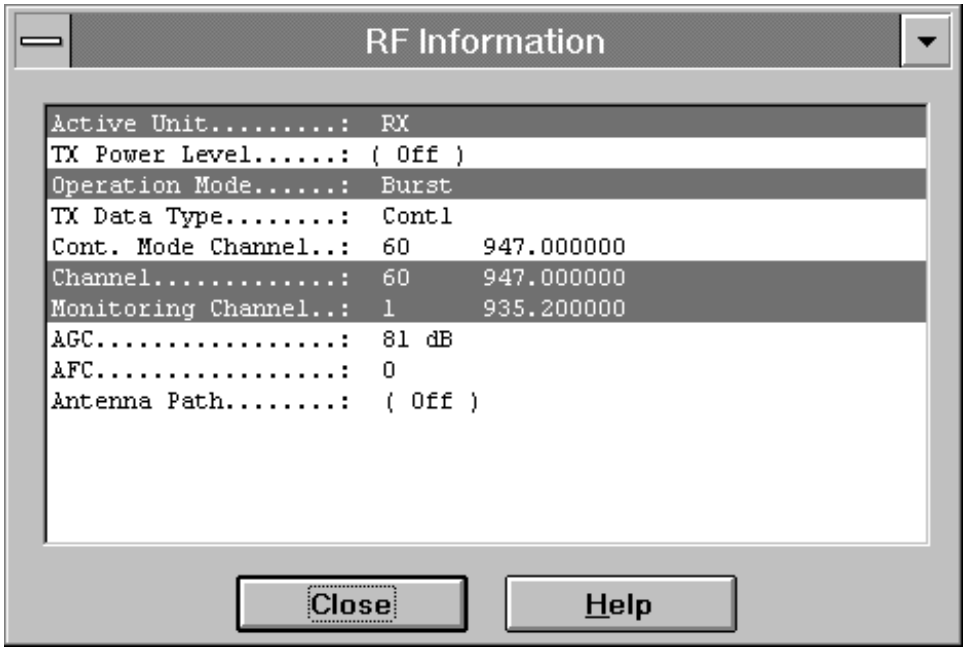
Activation	Status Bar Text
Alt, V, Q	View Quick/RF information

If phone is in *normal* mode, the following **Quick Info** is shown:



Note! Special conditions (For example, if the phone's SIM lock is ON) cause this dialog box to change color to make this special condition clear to the user.

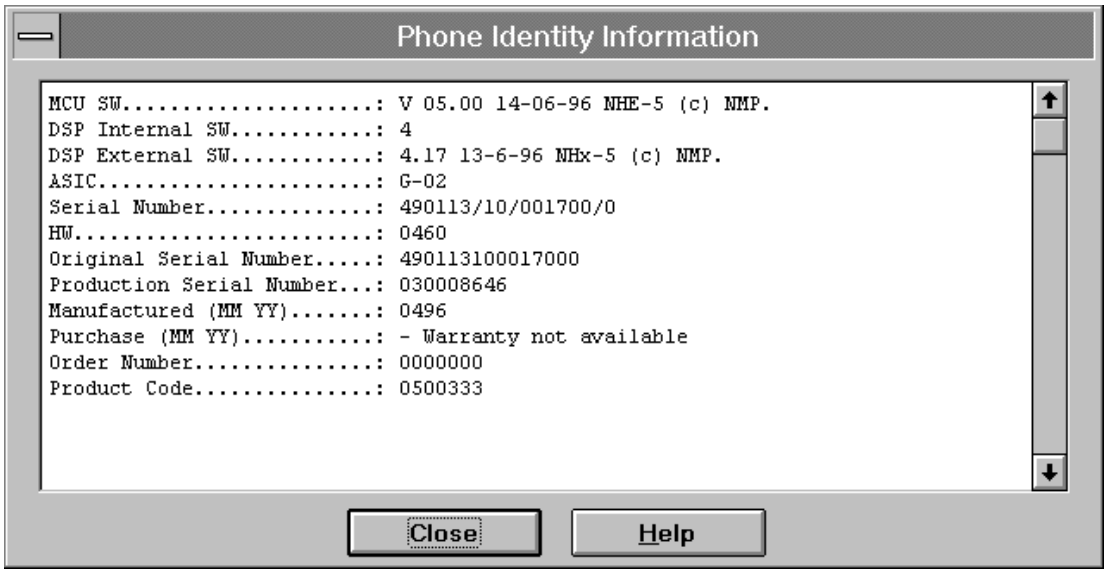
If the phone is in local mode, the following **RF Information** is shown. Information is shown in a modeless dialog box which may be left open during other operations. It is also updated when ever needed.



Phone Identity... command

Activation	Status Bar Text
Alt, V, P	View phone identity

The command opens the **Phone Identity Information** dialog box, which shows identification information. Information is shown in a modeless dialog box, which may be left open during other operations. It is also updated when ever needed.



Help

The Help menu offers commands which provide assistance with this application:.

Index command

Activation	Status Bar Text
Alt, H, I	Provide general instructions on using help

The command displays the opening screen of Help. From the opening screen, the user can jump to step–by–step instructions for using Service Software and various types of reference information.

Once Help is opened, the user can click the Contents button whenever he wants to return to the opening screen.

General help command

Activation	Status Bar Text
Alt, H, G	General help

Using Help command

Item	Activation	Status Bar Text
Using Help	Alt, H, U SHIFT F1	Display using help system information

About... command

Activation	Status Bar Text
Alt, H, A	Displays the version number of this application

See **Login Dialog.**

Initialization File

The service software has its own initialization file which has the extension .INI. The Initialization file is TESLA.INI and includes all the following selections (in mentioned menus or dialog boxes) and parameters:

RF Controls dialog box ([NHE/K–5 RF])

- Channel (Channel =)
- Continuous Mode Channel (Cont Mode Channel =)
- Monitoring Channel (Monitoring Channel =)
- AFC (AFC =)
- AGC (AGC =)
- Data Type (DataType=)
- Power Level (PowerLevel =)

DLL Filenames (NHE–5 and identical NHE–6)

- User Interface (UserInterface=)
- Functionality (Functionality=)

RSSI Dialog box (NHE–5LEVELS and identical NHE–6LEVELS)

- AFC Level (AfcLevel=)
- RSSI Low (RssiLow=)
- RSSI High (RssiHigh=)
- AFC Level (AfcLevel=)

Appendix 1, Vocabulary

Appreviation	Description
API	Application Programming Interface
ASIC	Custom circuit which for instance controls communication between MCU and DSP
CLF	Common Look and Field
DATA	DATA interface module
DAU–4S	M2BUS – RS–232 adapter
DCT2	Digital Core Technology Second Generation
DLL	Dynamic Link Library
DSP	Digital signal processor which controls radio interface and speech coding/decoding
EEPROM	Memory for adjustment parameters (Electrically Erasable and Programmable Read Only Memory)
IMEI	International Mobile Equipment Identification code
M2BUS	Serial communication bus which can be connected to accessory devices and test PC
MCU	Master Control Unit processor
MDI	MCU DSP Interface; message interface via ASIC registers
ME	Mobile Equipment
MFC	Microsoft Foundation Class library
MS	Mobile Station
MTI	Message Transfer Interface
PC	IBM PS/AT or compatible personal computer
PCBOX	Local Net driver SW for PC
PCI	Phone Controlling Interface SW for PC
PKD	Parallel Port Software Protection Device
RF	Radio Frequency parts
RFI	Radio Frequency Interface circuit
SW	Software
UI	User Interface

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Chapter 4

SYSTEM MODULE

Original, 06/96

CHAPTER 4 – SYSTEM MODULE

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Introduction

GT8 is the baseband/RF module NHE–5 cellular tranceiver. The GT8 module carries out all the system and RF functions of the tranceiver. System module GT8 is designed for a handportable phone, that operate in GSM system.

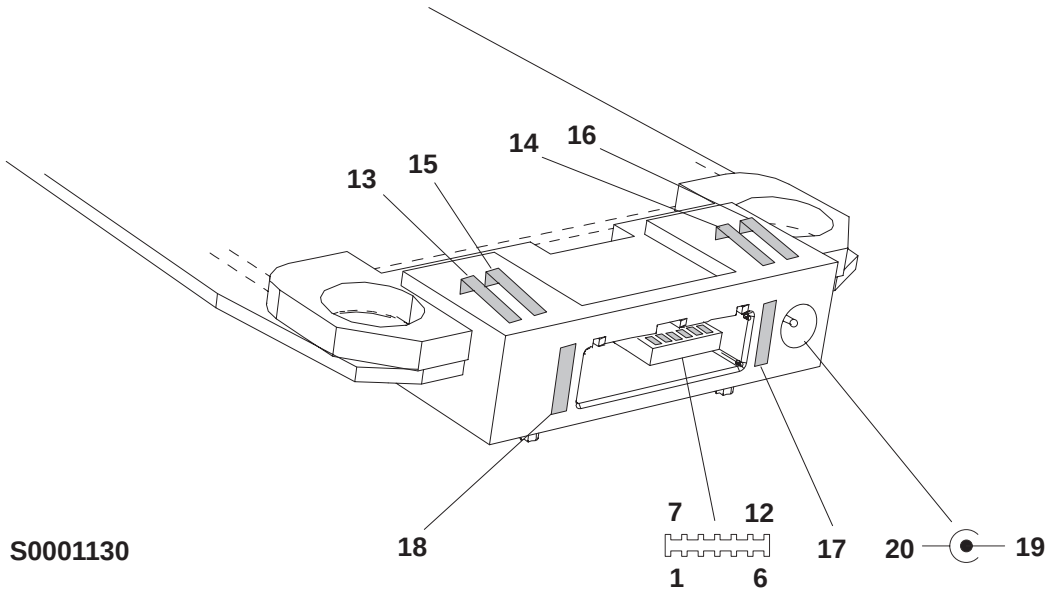
Technical Section

All functional blocks of the system module are mounted on a single multi layer printed circuit board. The chassis of the radio unit has separating walls for baseband and RF. All components of the baseband section are surface mountable. They are soldered using reflow. The connections to accessories are taken through the bottom connector of the radio unit. The connections to the User Interface module (UIF) are fed through a connector. There is no physical connector between the RF and baseband sections.

External and Internal Connections

The system module has two connector, external bottom connector and internal display module connector.

System Connector X103



Accessory Connector

Pin:	Name:	Description:
1	GND	Digital ground
2	V_OUT	Accessory output supply • min/typ/max: 3.25...10 V (output current 50 mA)
3	XMIC	External microphone input and accessory identification • nom/max: 8...50 mV (the maximum value corresponds to 0 dBm network level with input amplifier gain set to 20 dB, typical value is maximum value –16 dB)
	ID	Accessory identification • 1.7...2.05 V headset adapter connected • 1.15...1.4 V compact hadsfree unit connected
4	NC	No connection
5	NC	No connection
6	MBUS	Serial control bus • logic low level: 0...0.5 V • logic high level: 2.4...3.2 V
7	NC	No connection
8	SGND	Signal ground
9	XEAR	External audio output and mute control • min/nom/max: 0...32...500 mV (typical level correnspondsto –16 dBm0 network level with volume control in nominal position 8 dB below maximum. Maximum 0 dBm0 max. volume codec gain –6 dB) • mute on (HF speaker mute): 0...0.5 V d.c. • mute off (HF speaker active): 1.0...1.7 V d.c.
10	HOOK	Hook control, accessory connection detect • hook off (handset in use) : 0...0.5 V • hook on, (handset not in use): 2.4...3.2 V
11	NC	No connection
12	V_IN	Charging supply voltage • max: 16 V

Battery Connector

Pin:	Name:	Description:
13	BGND	Battery ground
14	BSI	Battery size indicator (used also for SIM card detection) • R2=47k pullup resistor in module
15	BTEMP	Battery temperature (used also for vibration alert) • 47 kΩ NTC in battery to gnd, 47 kΩ pullup in module
16	VB	Battery voltage • min/typ/max: 5.3...6...8.6 V

Charging connectors

Pin:	Name:	Description:
17, 19	V_IN	Charging voltage input • ACH–6 min/nom/max: 9.8...10.3...10.8 V • ACH–8 min/nom/max: 12...14...16 V
18, 20	GND	Charger ground

UI Connector X101

Pin:	Name:	Description:
1	EARP	Earphone positive signal • min/typ/max: 0...14...220 mV (typical level correnspondes to –16 dBm0 network level with volume control giving nominal RLR (=+2 dB) 8 dB below maximum. Maximum 0 dBm0 with max. volume (codec gain –11 dB)
2	EARN	Earphone negative signal • min/typ/max: 0...14...220 mV (see above)
3	VBKEY	Battery supply • min/max: 5.3...8.5 V
4	BUZZER	Alert buzzer (audio codec PWM controlled)
5–7	ROW(0–2)	Input
8–10	GND	Shield ground
11–13	ROW(3–5)	Input

Pin:	Name:	Description:
14	LIGHTC	Keyboard light
15–18	COL(0–3)	Output
19	PWRKEY	Power on/off
20	GND	Digital ground

Flash Connector X103

Pin:	Name:	Description:
1	WDDIS	Watchdog disable, signal pulled down to disable watchdog, test point J300
2	FCLK	Flash serial clock, test point J303
3	VPP	Flash programming voltage • min/typ/max: 11.4...12...12.6 V (values when VPP active), test point J304
4	FTX	Flash acknowledge transmit, test point J302
5	FRX	Flash data receive, test point J301

SIM Connector X102

Pin:	Name:	Description:
1	GND	Ground for SIM
2	VSIM	SIM voltage supply • min/typ/max: 4.8...4.9...5.0 V
3	SDATA	Serial data for SIM
4	SRES	Reset for SIM
5	CLK	Clock for SIM data (clock frequency minimum 1 MHz if clock stopping not allowed)

Baseband Block

Introduction

The GT8 module is used in NHE–5 products. The baseband is built around one DSP, System ASIC and the MCU. The DSP performs all speech and GSM/PCN related signal processing tasks. The baseband power supply is 3V except for the A/D and D/A converters that are the interface to the RF section. The A/D converters used for battery monitoring are integrated into the same device as the signal processing converters.

The audio codec is a separate device which is connected to both the DSP and the MCU. The audio codec support the internal and external microphone/ear-piece functions. External audio is connected in a dual ended fashion to improve audio quality together with accessories.

The baseband implementation support a 32 kHz sleep clock function for power saving. The 32 kHz clock is used for timing purposes during inactive periods between paging blocks. This arrangement allows the reference clock, derived from RF to be switched off.

The baseband clock reference is derived from the RF section and the reference frequency is 13 MHz. a low level sinusoidal wave form is fed to the ASIC which acts as the clock distribution circuit. The DSP is running at 39 MHz using an internal PLL. The clock frequency supplied to the DSP is 13 MHz. The MCU bus frequency is the same as the input frequency. The system ASIC provides both 13 MHz and 6.5 MHz as alternative frequencies. The MCU clock frequency is programmable by the MCU. The baseband uses 6.5 MHz as the MCU operating frequency. The RF A/D, D/A converters are operated using the 13 MHz clock supplied from the system ASIC

The power supply and charging section supplies several types of battery technologies. such as , NiCd, NiMH and Lithium. The battery charging unit is designed to accept constant current type chargers, that are approved by NMP.

The power supply IC contains three different regulators. The output voltage from each regulator is 3.15V nominal. One of the regulator uses an external transistor as the boost transistor.

Modes of Operation

The baseband in operates in the following Modes

– Active, as during a call or when baseband circuitry is operating

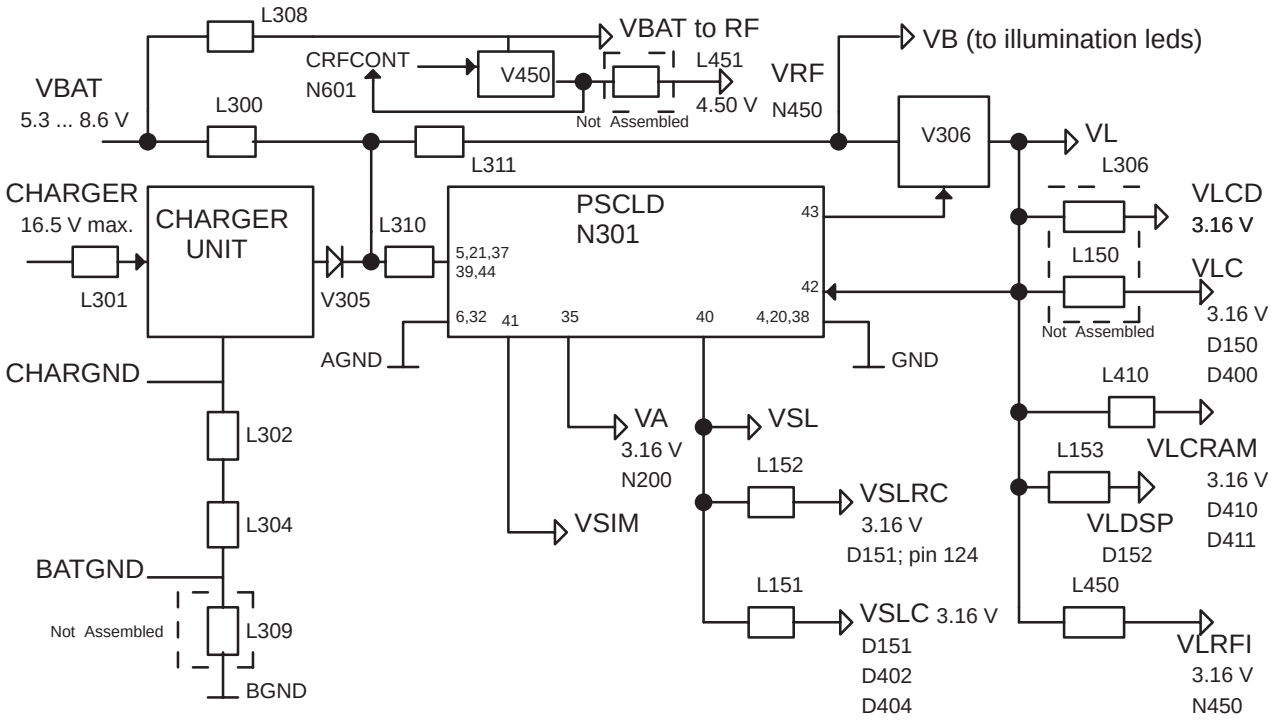
– Sleep, in this mode the clock to the baseband is stopped and timing is kept by the 32 KHz oscillator. All Baseband circuits are powered

– Acting dead, in this mode the battery is charged but only necessary functions for charging are running

– Power off, in this mode all baseband circuits are powered off. The regulator IC N301 is powered

Circuit Description

Power Supply



The power supply for the baseband is the main battery. The main battery consists of 5 NiCd or NiMH cells with a nominal voltage of 6.0V. A charger input is used to charge the battery. Two different chargers can be used for charging the battery. A switch mode type fast charger that can deliver 780 mA and a standard charger that can deliver 265 mA. The idle voltage for the fast and standard charger see NO TAG. Both chargers are of constant current type.

The baseband has one power supply circuit, N301 delivering power to the different parts in the baseband. There are two logic power supply and one analog power supply. The analog power supply VA is used for analog circuits such as audio codec, N200 and microphone bias circuitry. Due to the current consumption and the baseband architecture the digital supply is divided into to parts.

Both digital power supply rails from the N301, PSCLD is used to distribute the power dissipation inside N301, PSCLD. The main logic power supply VL has an external power transistor, V306 to handle the power dissipation that will occur when the battery is fully charged or during charging.

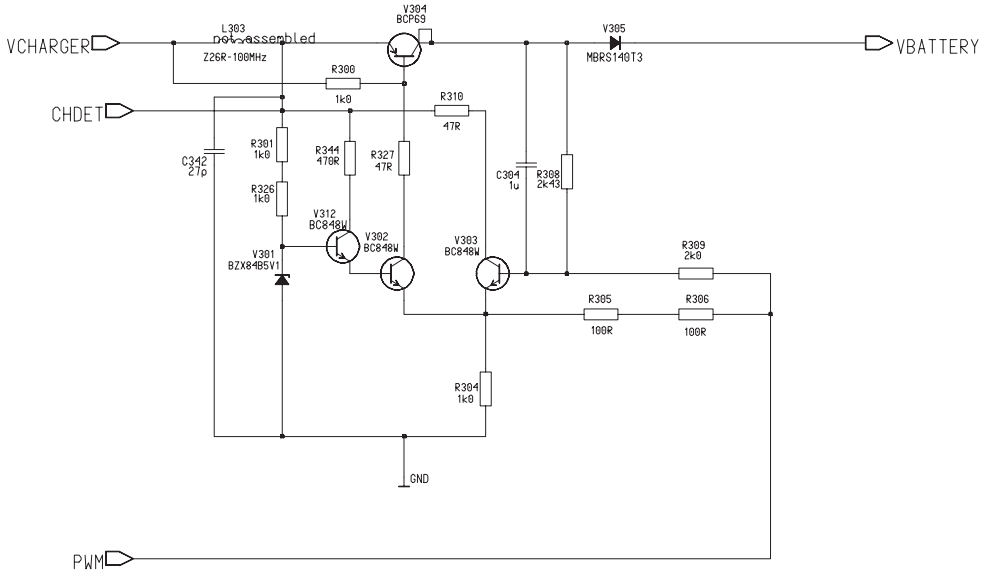
D151, ASIC and the MCU SRAM, D402/D403 are connected to the same logic supply voltage. All other digital circuits are connected to the main digital supply. The analog voltage supply is connected to the audio codec.

Charging Control Switch Functional Description

The charging switch transistor V304 controls the charging current from the charger input to the battery. During charging the transistor is forced in saturation and the voltage drop over the transistor is 0.2–0.4V depending upon the current delivered by the charger. Transistor V304 is controlled by the PWM output from N301, pin 23 via resistors R309, R308 and transistor V303. The output from N301 is of open drain type. When transistor V304 is conducting the output from N301 pin is low. In this case resistors R305 and R306 are connected in parallel with R304. This arrangement increases the base current through V304 to put it into saturation.

Transistors V304, V302, V303 and V312 forms a simple voltage regulator circuitry. The reference voltage for this circuitry is taken from zener diode V301. The feedback for the regulator is taken from the collector of V304. When the PWM output from N301 is active, low, the feedback voltage is determined by resistors R308 and R309. This arrangement makes the charger control switch circuitry to act as a programmable voltage regulator with two output voltages depending upon the state of the PWM output from N301. When the PWM is inactive, in high impedance the feedback voltage is almost the same as on the collector of V304. Due to the connection the voltage on V303 and V302 emitters are the same. The influence of the current thru R305 and R306 can be neglected in this case.

The charging switch circuit diagram is shown in following figure. The figure is for reference only.



This feedback means that the system regulates the output voltage from V304 in such a way that the base of V303 and V302 are at the same voltage. The voltage on V302 is determined by the V301 zener voltage. The darlington connection of V312 and V302 service two purposes 1 the load on the voltage reference V301 is decreased, 2 the output voltage on V304 is decreased by the VBE voltage on V312 which is a wanted feature. The voltage reduction allows a relative temperature stable zener diode to be used and the output voltage from V304 is at a suitable level when the PWM output from N301 is not active.

The circuitry is self starting which means that an empty battery is initially charged by the regulator circuitry around the charging switch transistor. The battery is charged to a voltage of maximum 4.8V. This charging switch circuitry allows for both NiCd, NiMH and Lithium type of batteries to be used.

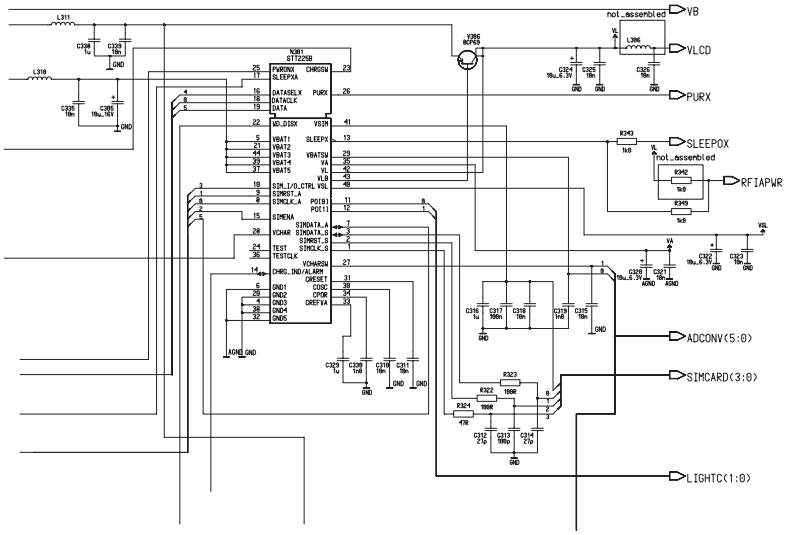
When the PWM output from N301 is active the feedback voltage is changed due to the presence of R308 and R309. When the PWM is active the charging switch regulator voltage is set to 10.5V maximum. This means that even if the voltage on the charger input exceeds 11.5V the battery voltage will not exceed 10.5 V. This protects N301 from over voltage even if the battery was to be detached while charging.

V305 is a schottky diode that prevents the battery voltage from reverse bias V304 when the charger is not connected. The leakage current for V305 is increasing with increasing temperature and the leakage current is passed to ground via R308, V303 and R304. This arrangement prevents V304 from being reversed biased as the leakage current increases at high temperatures.

V300 is a 16V transient suppressor. V300 protects the charger input and in particular V304 for over voltage. The cut off voltage is 16V with a maximum surge voltage up to 25V. V300 also protects the input for wrong polarity since the transient suppressor is bipolar.

Power Supply Regulator PSCLD, N301

The power supply regulators are integrated into the same circuit N301. The power supply IC contains three different regulators. The main digital power supply regulator is implemented using an external power transistor V306. The other two regulators are completely integrated into N301.



PSCLD, N301 External Components

N301 performs the required power on timing. The PSCLD, N301 internal power on and reset timing is defined by the external capacitor C330. This capacitor determines the internal reset delay, which is applied when the PSCLD, N301 is initially powered by applying the battery. The baseband power on delay is determined by C311. With a value of 10 nF the power on delay after a power on request has been active is in the range of 50–150 ms. C310 determines the PSCLD, N301 internal oscillator frequency and the minimum power off time when power is switched off.

The sleep control signal from the ASIC, D151 is connected via PSCLD, N301. During normal operation the baseband sleep function is controlled by the ASIC, D151 but since the ASIC is not power up during the startup phase the sleep signal is controlled by PSCLD, N301 as long as the PURX signal is active. This arrangement ensures that the 13 MHz clock provided from RF to the ASIC, D151 is started and stable before the PURX signal is released and the baseband exits reset. When PURX is inactive, high, sleep control signal is controlled by the ASIC D151.

N301 requires capacitors on the input power supply as well as on the output from each regulator to keep each regulator stable during different load and temperature conditions. C305 and C335 are the input filtering capacitors. Due to EMC precautions a filter using C337, L310, C335, L311, C338 and C339 has been inserted into the supply rail. This filter reduces the high frequency components present at the battery supply from exiting the baseband into the battery pack. The regulator outputs also have filter capacitors for power supply filtering

and regulator stability. A set of different capacitors are used to achieve a high bandwith in the suppression filter.

PSCLD, N301 Control Bus

The PSCLD, N301 is connected to the baseband common serial control bus, SCONB(5:0). This bus is a serial control bus from the ASIC, D151 to several devices on the baseband. This bus is used by the MCU to control the operation of N301 and other devices connected to the bus. N301 has two internal 8 bit registers and the PWM register used for charging control. The registers contain information for controlling reset levels, charging HW limits, watchdog timer length and watchdog acknowledge.

The control bus is a three wire bus with chip select for each device on the bus and serial clock and data. From PSCLD, N301 point of view the bus can be used for writing only. It is not possible to read data from PSCLD, N301 by using this bus.

The MCU can program the HW reset levels when the baseband exits/enters reset. The programmed values remains until PSCLD is powered off, the battery is removed. At initial PSCLD, N301 power on the default reset level is used. The default value is 5.1 V with the default hysteresis of 400 mV. This means that reset is exit at 5.5 V when the PSCLD, N301 is powered for the first time.

The watchdog timer length can be programmed by the MCU using the serial control bus. The default watchdog time is 32 s with a 50 % tolerance. The complete baseband is powered off if the watchdog is not acknowledged within the specified time. The watchdog is running while PSCLD, N301 is powering up the system but PURX is active. This arrangement ensures that if for any reason the battery voltage doesn’t increase above the reset level within the watchdog time the system is powered off by the watchdog. This prevents a faulty battery from being charged continuously even if the voltage never exceeds the reset limit. As the time PURX is active is not exactly known, depends upon startup condition, the watchdog is internally acknowledged in PSCLD when PURX is released. This gives the MCU always the same time to respond to the first watchdog acknowledge.

Baseband power off is initiated by the MCU and power off is performed by writing the smallest value to the watchdog timer register. This will power off the baseband within 0.5 ms after the watchdog write operation.

The PSCLD, N301 also contains switches for connecting the charger voltage and the battery voltage to the baseband A/D converters. Since the battery voltage is present and the charger voltage might be present in power off the A/D converter signals must be connected using switches. The switch state can be changed by the MCU via the serial control bus. When PURX is active both switches are open to prevent battery/charger voltage from being applied to the baseband measurement circuitry which is powered off. Before any measurement can be performed both switches must be closed by MCU.

Charger Detection

A charger is detected if the voltage on N301 pin 28 is higher than 0.5V. The charger voltage is scaled externally to PSCLD, N301 using resistors R302 and R303. With the implemented resistor values the corresponding voltage at the charger input is 2.8V. Due to the multifunction of the charger detection signal from PSCLD, N301 to ASIC, D151 the charger detection line is not forced ,active high until PURX is inactive. In case PURX is inactive the charger detection signal is directly passed to D151. The active high on pin 14 generates and interrupt to MCU which then starts the charger detection task in SW.

SIM Interface and Regulator in N301

The SIM card regulator and interface circuitry is integrated into PSCLD, N301. The benefit from this is that the interface circuits are operating from the same supply voltage as the card, avoiding the voltage drop caused by the external switch used in previous designs. The PSCLD, N301 SIM interface also acts as voltage level shifting between the SIM interface in the ASIC, D151 operating at 3V and the card operating at 5V. Interface control in PSCLD is direct from ASIC, D151 SIM interface using SIMI(5:0) bus. The MCU can select the power supply voltage for the SIM using the serial control bus. The default value is 3V which needs to be changed to 5V before power up the SIM interface in ASIC, D151. Regulator enable and disable is controlled by the ASIC via SIMI(2). For further operation of the SIM interface see section NO TAG.

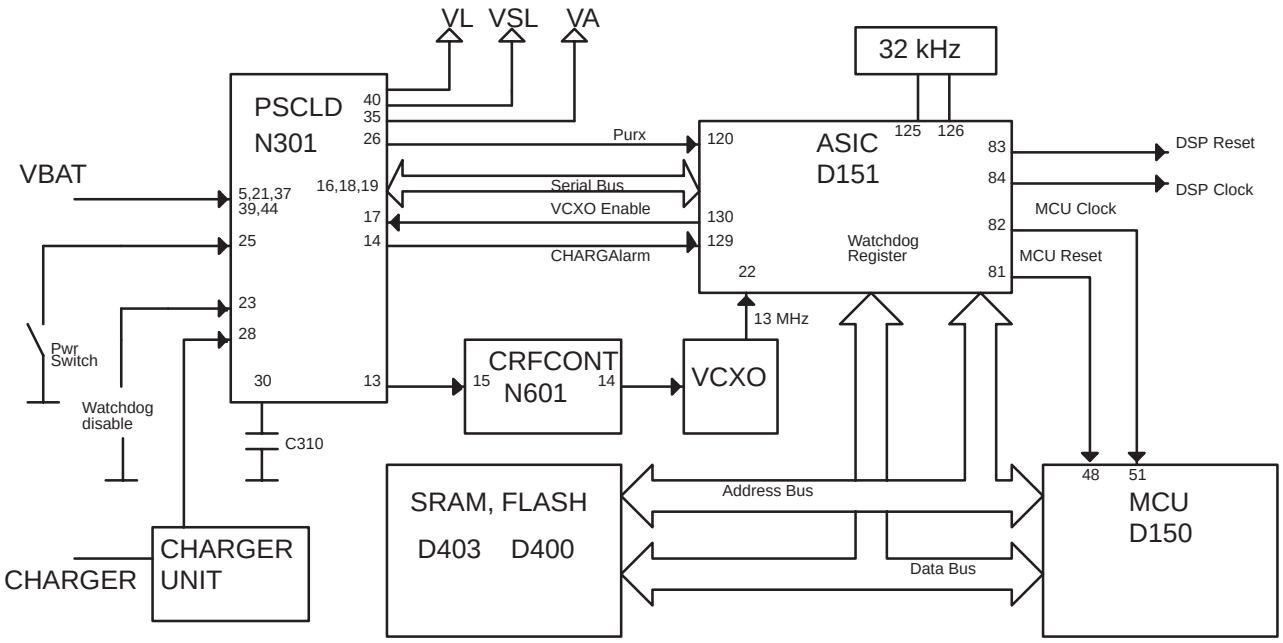
Power Up Sequence

The baseband can be powered up in three different ways.

– When the power switch is pressed input pin 25 to PSCLD, N301 is connected to ground and this switches on the regulators inside PSCLD.

– An other way to power up is to connect the charger. Connecting the charger causes the baseband to power up and start charging the battery.

– The third way to power the system up is to attach the battery.



Power up using Power on Button

This is the most common way to power the system up. This power up is successful if the battery voltage is higher than power on reset level set by the MCU, default value 5.5V in PSCLD, N301. The power up sequence is started when the power on input pin 25 at PSCLD is activated, low. The PSCLD then internally enters the reset state where the regulators are switched on. At this state the PWM output from PSCLD is forced active to support additional power from any charger connected. The sleep control output signal is forced high enabling the regulator to supply the VCO and startup the clock. After the power on reset delay of 50–150 ms PURX is released and the system exits reset. The PWM output is still active until the MCU writes the first value to the PWM register. The watchdog has to be acknowledged within 16 s after that PURX has changed to inactive state

Power Up with Empty Battery using Charger

When the charger is inserted into the DC jack or charger voltage is supplied at the system connector surface contacts/pins PSCLD , N301 powers up the baseband. The charging control switch is operating as a linear regulator, the output voltage is 4.5V–5V. This allows the battery to be charged immediately when the charger is connected. This way of operation guarantees successful power up procedure with empty battery. In case of empty battery the only power source is the charger. When the battery has been initially charged and the voltage is higher than the PSCLD, N301 switch on voltage the sleep control signal which is connected to the PSCLD for power saving function sleep mode, enters inactive state, high, to enable the regulator that controls the power supply to the VCO to be started. The ASIC, D151 which normally controls the sleep control line has the sleep output inactive, low as long as the system reset, PURX is active, low, from PSCLD. After a delay of about 5–10 ms the system

reset output PURX from PSCLD enters high state. This delay is to ensure that the clock is stable when the ASIC exits reset. The sleep control output from the PSCLD that has been driving an output until now, returns the control to the sleep signal from the ASIC as the PURX signal goes inactive. When the PURX signal goes inactive, high, the charge detection output at PSCLD, that is in input mode when PURX is active, switches to output and goes high indicating that a charger is present. When the system reset, PURX, goes high the sleep control line is forced inactive, high, by the ASIC, D151 via PSCLD, N301.

Once the system has exited reset the battery is initially charged until the MCU writes a new value to the PWM in PSCLD. If the watchdog is not acknowledged the battery charging is switched off when the PSCLD shuts off the power to the baseband. The PSCLD will not enter the power on mode again until the charger has been extracted and inserted again or the power switch has been pressed. The battery is charged as long as the power on line, PWRONX is active low. This is done to allow the phone to be started manually from the power button with the charger inserted not having to extract the charger to get a power up if the battery is empty.

Power On Reset Operation

The system power up reset is generated by the regulator IC, N301. The reset is connected to the ASIC, D151 that is put into reset whenever the reset signal, PURX is low. The ASIC, D151 then resets the DSP, D152 the MCU, D150 and the digital parts in N450. When reset is removed the clock supplied to the ASIC, D151 is enabled inside the ASIC. At this point the 32 kHz oscillator signal is not enabled inside the ASIC, since the oscillator is still in the startup phase. To start up the block requiring 32 kHz clock the MCU must enable the 32 kHz clock. The MCU reset counter is now started and the MCU reset is still kept active, low. 6.5 MHz clock is started to MCU in order to put the MCU, D150 into reset, MCU is a synchronous reset device and needs clock to reset. The reset to MCU is put inactive after 128 MCU clock cycles and MCU is started.

DSP, D152 and N450 reset is kept is kept active when the clock inside the ASIC, D151 is started. 13 MHz clock is started to DSP, D152 and puts it into reset, D152 is a synchronous reset device and requires clock to enter reset. N450 digital parts are reset asynchronously and do not need clock to be supported to enter reset.

As both the MCU, D151 and DSP, D152 are synchronous reset devices all interface signals connected between these devices and ASIC D151 which are used as I/O are set into input mode on the ASIC, D151 side during reset. This avoids bus conflicts to occur before the MCU, D150 and the DSP, D152 are actually reset.

The DSP, D152 and N450 reset signal remains active after that the MCU has exited reset. The MCU writes to the ASIC register to disable the DSP reset. This arrangement allows the MCU to reset the DSP, D152 and N450 when ever needed. The MCU can put DSP into reset by writing the reset active in the ASIC, D151 register

MCU

The baseband uses a Hitachi H3001 type of MCU. This is a 16–bit internal MCU with 8–bit external data bus. The MCU is capable of addressing up to 16 MByte of memory space linearly depending upon the mode of operation. The MCU has a non multiplexed address/data bus which means that memory access can be done using less clock cycles thus improving the performance but also tightening up memory access requirements. The MCU is used in mode 3 which means 8–bit external data bus and 16 Mbyte of address space. The MCU operating frequency is equal to the supplied clock frequency. The MCU has 512 bytes of internal SRAM. The MCU has one serial channel, USART that can operate in synchronous and asynchronous mode. The USART is used in the MBUS implementation. Clock required for the USART is generated by the internal baud rate generator. The MCU has 5 internal timers that can be used for timing generation. Timer TIOCA0 input pin 71 is used for generation of net-free signal from the MBUS receive signal which is connected to the MCU USART receiver input on pin 2.

The MCU contains 4 10–bit A/D converters channels that are used for baseband monitoring. For A/D converter channel usage see section NO TAG.

The MCU, D150 has several programmable I/O ports which can be configured by SW. Port 4 which multiplexed with the LSB part of the data bus is used baseband control. In the mode the MCU is operating this port can be used as an I/O port and not as part of the data bus, D0–D7.

MCU Access and Wait State Generation

The MCU can access external devices in 2 state access or 3 state access. In two state access the MCU uses two clock cycles to access data from the external device In 3 state access the MCU uses 3 clock cycles to access the external device or more if wait states are enabled. The wait state controller can operate in different modes. In this case the programmable wait mode is used. This means that the programmed amount of wait states in the wait control register are inserted when an access is performed to a device located in that area. For area split see NO TAG. The complete address space is divided into 8 areas each area covering 2 MByte of address space. The access type for each area can be set by bits in the access state control register. Further more the wait state function can be enabled separately for each area by the wait state controller enable register.

This means that in 3 state access two types of acccess can be performed with a fixed setting:

– 3 state access without wait states

– 3 state access with the amount of wait states inserted determined by the wait control register

If the wait state controller is not enabled for a 3 state access area no waits states are inserted when accessing that area even if the wait control register contains a value that differs from 0 states.

MCU Flash Loading

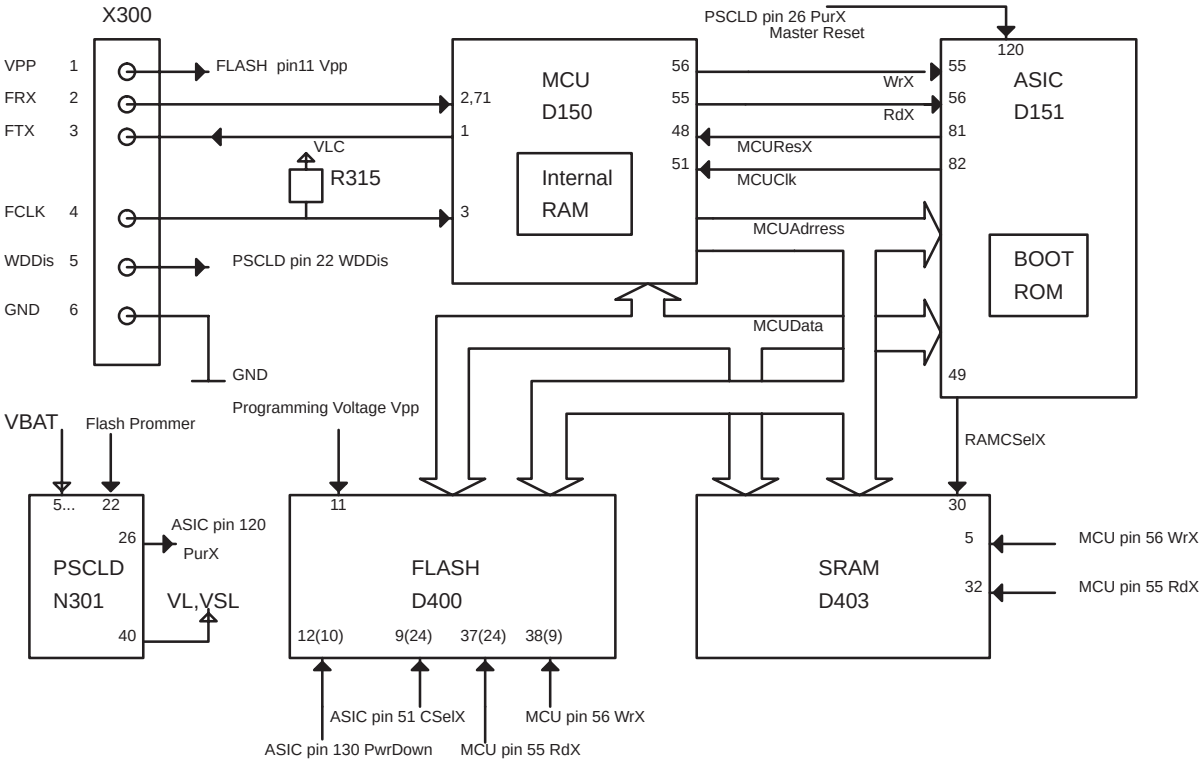
The flash loading equipment is connected to the baseband by means of the test connector before the module is cut out from the frame. Updating SW on a final product is done by removing the battery and connect a special battery that contains the necessary contacting elements. The contacts on the baseband board are test points that are accessable when the battery is detached. The power supply for the base band is supplied via the adapter and controlled by the flash programming equipment. The base band module is powered up when the power is connected to the battery contact pins.

Five signals are required for the flash programming, with the addition of the battery supply. The baseband MCU will automatically wait for flash down loading to be performed if one of the two following criteria are met.

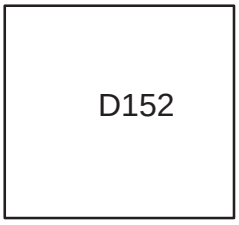
– The flash is found to be empty when tested by the MCU
– The serial clock line at the baseband MCU is forced low when the MCU is exiting reset

The second alternative is used for reprogramming as the flash is not empty in this case. To allow the serial clock line to be forced low during MCU initial boot there is a requirement that the flash prommer can control the power on of the baseband module. This is done by controlling the switching of the battery power supply. This arrangement allows the baseband module to operate in normal mode even if the flash prommer is connected but not active. The flash prommer also disables the power supply watchdog during flash programming to prevent unwanted power off of the baseband. The programming voltage to the flash is applied when the flash prommer has detected that the baseband module is powered. This detection is performed by monitoring the serial interface RX line from the baseband. The RX line is pulled high by a pullup resistor in idle. The VPP voltage is set to 5V as it is not known at this point what type of device is used.

The following diagram shows the block diagram for the baseband flash programming circuitry.



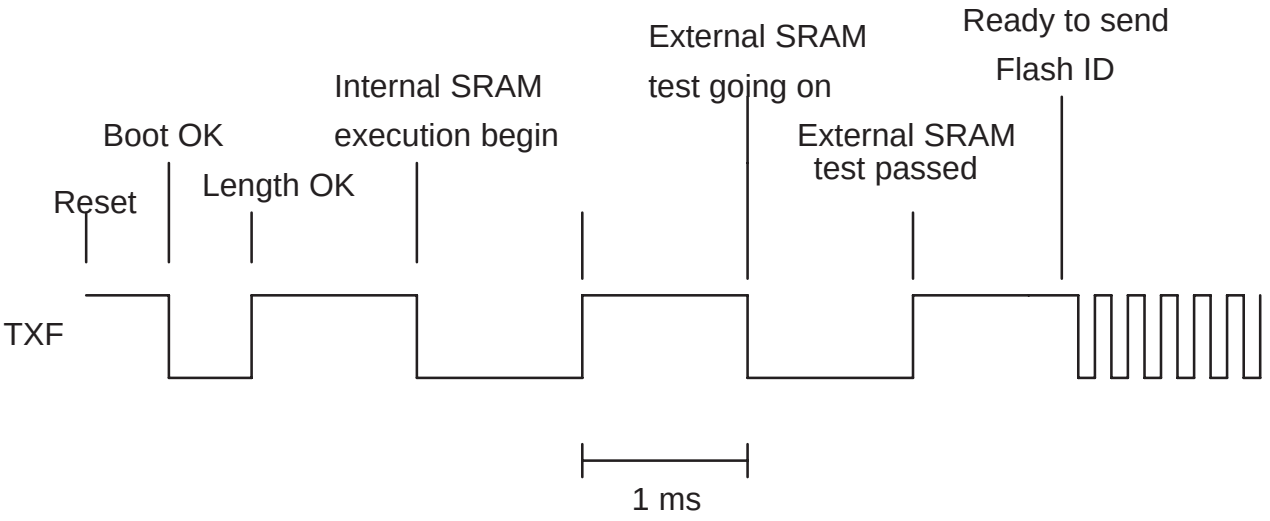
The following picture shows the location of the flash programming contact pads on the PCB. These pads are used for SW updating at after sales locations. A special battery pack is used for this purpose. The battery pack contains contacting elements that can access these pads without having to disassemble the phone.



The interface lines between the flash prommer and the baseband are in low state when power is not connected by the flash prommer. The data transfer between the flash programming equipment and the base band is synchronous and the clock is generated by the flash prommer. The same MCU USART that is used for MBUS communication is used for the serial synchronous communication. The PSCLD watchdog is disabled when the flash loading battery pack and cable is connected.

After the flash battery pack adapter has been mounted or the test connector has been connected to the board the power to the baseband module is connected by the flash prommer or the test equipment. All interface lines are kept low except for the data transmit from the baseband that is in reception mode on the flash prommer side, this signal is called TXF. The MCU boots from ASIC and investigates the status of the synchronous clock line. If the clock input line from the flash prommer is low or no valid SW is located in the flash MCU forces the initially high TXF line low acknowledging to the flash prommer that it is ready to accept data.

The flash prommer sends data length, 2 bytes, on the RXF data line to the baseband. The MCU acknowledges the 2 data byte reception by pulling the TXF line high. The flash prommer now transmits the data on the RXF line to the MCU. The MCU loads the data into the internal SRAM. After having received the transferred data correctly MCU puts the TXF line low and jumps into internal SRAM and starts to execute the code. After a guard time of 1 ms the TXF line is put high by the MCU. After 1 ms the TXF is put low indicating that the external SRAM test is going on. After further 1 ms the TXF is put high indicating that external SRAM test has passed. The MCU performs the flash memory identification based upon the identifiers specified in the Flash Programming Specifications. In case of an empty device, identifier locations shows FFH, the flash device code is read and transmitted to the Flash Prommer.



After that the device mounted on base band has been identified the Flash Prommer down loads the appropriate algorithm to the baseband. The programming algorithm is stored in the external SRAM on the baseband module and after having down loaded the algorithm and data transfer SW, MCU jumps to the external SRAM and starts to execute the code.

The MCU now asks the prommer to connect the flash programming power supply. This SW loads the data to be programmed into the flash and implements the programming algorithm that has been down loaded.

Flash Prommer Connection Using Dummy Battery

For MCU SW updating in the field a special battery adapter can be used to connect to the test points which are accessable through 5 holes in the chassis, located behind the battery. Supply voltage must be connected to this dummy battery as well as the flash programming equipment

Flash, D400

A 4 MBit Boot Block flash is used as the main program memory, D400 the device is 3 V read/program with external 12V VPP for programming. The device has a lockable boot sector. This function is not used since the complete code is reprogrammed. The Boot sector is located at the ”bottom”, definition by Intel, address 00000H–03FFFH. The block is unlocked by a logic high state on pin 12. This logic high level is generated from VPP. The device can be programmed by a VPP of 5V but the programming procedure takes longer. To improve programming the programming voltage used is 12V. The speed of the device is 110 ns although the requirement is 150 ns. The MCU operating at 6.5 MHz will access the flash in 2 state access, requiring 150 ns access time from the memory.

SRAM D402, D403

The baseband is designed to take two different size of SRAMs, 32kx8 and 128kx8, not at the same time. The required speed is 150 ns as the MCU will operate at 6.5 MHz and the SRAM will be accessed in 2 state access. The SRAM has no battery backup which means that the content is lost even during short power supply disconnections. As shown in the memory map the SRAM is not accessable after boot until the MCU has enabled the SRAM access by writing to the ASIC register.

EEPROM D401

The baseband is designed to take an 8kx8 parallel EEPROM. In addition to that a serial 2kx8 device using I2C bus is also designed on the baseband. HD842 will use the 2kx8 serial device over the I2C bus. The I2C bus protocol is implemented in SW and the physical implementation is performed on MCU Port 4.

The parallel device is connected to the MCU data and address bus. The ASIC generates chip select for the EERPROM. To avoid unwanted EEPROM access there is an EERPOM access bit in the ASIC MCU interface. This bit mus be set to allow for EERPOM access. This bit is cleared by default after reset. After each access this bit should be cleared to prevent unwanted EEPROM access. The parallel device used support page mode writing, 64 byte page. One page can be written by the MCU and after that the internal programming procedure is started. The page write operation is internally timed in the device and consecutive bytes must be written within 100 us. During this operation all interrupts must be disabled.

MCU and Peripherals

MCU Port P4 Usage

MCU, D150 port 4 is used for baseband control.

Port Pin	MCU pin	Control Function	Remark
P40	5	Display driver reset	Active low
P41	6		
P42	7		
P43	8		
P44	9	EEPROM SCK	
P45	10	EEPROM SDA	
P46	11	EEPROM write enable	Active low
P47	12	Headset mic amplifier bias	Active loew

Baseband A/D Converter Channels usage in N450 and D150

The auxiliary A/D converter channels inside RFI2, N450 are used by MCU to measure battery voltage. The A/D converters are accessed by the DSP, D152 via the ASIC, D151. The required resolution is 10 bit.

The MCU has 4 10 bit A/D channels which are used for baseband voltage monitoring. The MCU can measure charger voltage, battery size, battery temperature and accessory detection by using it’s own converters.

Baseband N450 A/D Converter Channel Usage

Name:	Usage:	Input volt. range	Remark
Chan 0	Battery voltage	5...9 V	Battery voltage when TX is active
Chan 1	Charger voltage	5...16 V	
Chan 2	Battery size indic.	0...3.2 V	
Chan 3	Battery temperature	0...3.2 V	
Chan 4	System board temp.	0...3.2 V	Not used
Chan 5	Accessory detection	0...3.2 V	
Chan 6		0...3.2 V	Not used
Chan 7	Battery voltage	5...9 V	Battery volt. TX inactive

MCU Baseband A/D Converter Channel Usage

Name:	Usage:	Input volt. range	Remark
Chan 0	Battery temperature	0...3.2 V	
Chan 1	Charger voltage	5...16 V	
Chan 2	Accessory detection	0...3.2 V	
Chan 3	Battery size indicator	0...3.2 V	

Battery Voltage Measurement

The battery voltage is measured using RFI2, N450 A/D converter channel 0 and 7. The converter value supplied from channel 7 is measured when the transmitter is active. This measurement gives the minimum battery voltage. The value from channel 0 is measured when the transmitter is inactive. The battery voltage supplied to the A/D converter input is switched off when the baseband is in power off. The battery voltage measurement voltage is supplied by PSCLD, N301 which performs scaling, the scaling factor is R1(R1+R2), and switch off. The measurement voltage is filtered by a capacitor to achieve an average value that is not depending upon the current consumption behavior of the baseband. To be able to measure the battery voltage during transmission pulse the time constant must be short. The value for the filtering capacitor is set to 1 nF, C319. The scaling factor used to scale the battery voltage must be 1:3, which means that 9V battery voltage will give 3V A/D converter input voltage. The A/D converter value in decimal can be calculated using the following formula:

$A/D = 1023xR1xU_{BAT}/((R1+R2)xU_{ref}) = 1023xU_{BAT}xK$

where K is the scaling factor. $K = R1/((R1+R2)xU_{ref)}$.

Charger Voltage Measurement

The charger voltage is measured to determine the type of charger used. MCU A/D converter channel 1 is used for this purpose. The input circuitry to the charger measurement A/D channel implements an LP–filter. The input voltage must be scaled before it is fed to the A/D converter input. Due to the high input voltage range scaling is performed outside PSCLD, N301. The scaling factor required is 22/(22+100) = 0.18. The charger voltage measurement switch is integrated into PSCLD, N301. Charger voltage is not supplied to the A/D converter input in power off mode. This is done to protect the A/D converter input in case power is switched off and the charger remains connected to the baseband. The charger A/D converter value can be calculated using the same formula as described in above section. The resistor values are different since the scaling factor is larger.

Battery Size Resistor Measurement

The battery size, capacity is determined by measuring the voltage on the BSI pin on the battery pack when the battery is attached to the phone. The MCU A/D converter channel 3 is used for this purpose. The BSI signal is pulled up on the base band using a 47 kohm resistor and the resistor inside the battery pack is reflecting the capacity of the battery. There are two special cases to be detected by the MCU. The first case is the Lithium battery. The Lithium battery has reserved values in the battery size table. Lithium type batteries are all the same from charging point of view. Lithium batteries are charged to a constant voltage and charging is aborted when the predefined voltage is reached. The Lithium battery capacity is a function of the battery voltage. The battery voltage drops linearly as the battery is discharged. The other case that has to be handled is the dummy battery. This battery is used for A/D converter field calibration at service centers and together with a defined voltage on the BTEMP pin on the battery pack to put the baseband into Local mode in production. Battery sizes below 250 mAh will be treated as dummy battery. The different battery size values are shown in tthe table below . The battery size A/D converter value can be calculated using the following formula:

$A/D = RSI/(RSI+47\ k\Omega)x1023$

where RSI is the value of the resistor inside the battery pack.

Battery Size and A/D Converter Value

Battery Type	Battery pack resistor	Capacity	BSI volt.	A/D conv value
Dummy	1 kΩ 2 %	<250 mAh	0.07	21 (83)
Standar battery	6.19 kΩ 2 %	900 mAh	0.37	119 (467)
Extended battery	9.09 kΩ 2 %	1200 mAh	0.52	166 (664)
Slim	3.3 kΩ 2 %	500 mAh	0.21	67 (268)
Lithium	68 kΩ 2 %	400 mAh	1.86	605 (2420)
Lithium	82 kΩ 2 %	8.6 V	2	650 (2601)

Battery Temperatur Measurement

The battery temperature is measured during charging. The BTEMP pin to the battery is pulled up on baseband by a 47 kohm resistor to logic supply voltage, 3.2V. The voltage on the BTEMP pin is a function of the battery pack temperature. Auxiliary A/D channel 3 is used for this purpose. Inside the battery pack there is a 47 kohm NTC resistor to ground. The A/D converter value can be calculated from the following formula:

A/D = RNTC/(RNTC+47 kohm)x1023

where RNTC is the value of the NTC resistor inside the battery pack.

The relation ship between different battery temperature, BTEMP voltage and A/D converter values are shown in following table.

A/D Converter Values for Different Battery Temperatures

Bat. temp.	NTC value	BTEMP voltage	A/D conv. value
Dummy	1 kΩ	0.06 V	21
–25	745.60 kΩ	2.96 V	962
0	164.96 kΩ	2.45 V	796
25	47 kΩ	1.58 V	512
50	16.26 kΩ	0.81 V	263
70	7.78 kΩ	0.45 V	145

Compact HF & Headset Detection

Auxiliary A/D channel 4 is used to detect accessories connected to the system connector using the XMIC. To be able to determine which accessory has been connected MCU measures the DC voltage on the XMIC input. The accessory is detected in accordance with the CAP Accessory specifications. Not all accessories are supported by the HD842 base band that are specified in the CAP Accessory specification.

The base band has a pull–up resistor network of 32 kohm to VA. The accessory has a pull down. The A/D converter value can be calculated using the following formula:

A/D = (ACCI+10 kΩ)/(ACCI+32 kΩ)x1023

where ACCI is the d.c. input impedance of the accessory device connected to the system connector.

The different values for acceptable accessories are given in the following table. The values in below table are calculated using 5 % resistor values and power supply range 3–3.3 V. Due to that the pull up resistor in the XMIC line is divided into two resistors the voltage at the A/D converter input is different from that on the XMIC.

Accessory Detection Voltage

Acc. type	Acc. resistance	Voltage on A/D converter channel 5 (min/typ/max)	A/D converter value(min/max)
Headset	47 kΩ	2.1...2.3...2.45	717...758
Compact HF	22 kΩ	1.7...1.9...2.05	581...631

Keyboard Interface

The keypad matrix is located on a PCB and the interface to the base band is by using connector X101. The electrical specifications are shown in NO TAG. The power on key is also connected to the PSCLD to switch power on. Due to the internal pull up inside PSCLD, N301 to a high voltage, a rectifier, V203 is required in the keypad matrix for the power on keypad to prevent the high voltage to interfere with the keypad matrix.

Series resistors, R261–R264 are implemented in the Column output to reduce the EMI radiation to the UI PCB. Capacitors C257–C260 reduces the EMC radiation and absorbs any ESD produced over an air gap to the keymat. As the serial display driver interface uses ROW5 for data transmission series resistors are needed to prevent keypad or double keypad pressing from interfering with the display communication. In a similar way R265–R269 in the ROW lines reduces the EMI to the UI board. Capacitors C251–C256 implements a LP–filter together with each resistor in the ROW line. The capacitors also absorbs ESD pulses over an air gap to the keymat.

During idle when no keyboard activity is present the MCU sets the column outputs to ”0” and enables the keyboard interrupt. An interrupt is generated when a ROW input is pulled low. Each ROW input on the ASIC, D151 has an internal pull–up. The keyboard interrupt starts up the MCU and the MCU starts the scanning procedure. As there are keypads to be detected outside the matrix the MCU sets all columns to ”1” and reads the ROW inputs if a logic ”0” is read on any ROW this means that one of the 6 possible non matrix keypads has been pressed. If the result was a ”1” on each ROW the MCU writes a ”0” on

each column consecutively while the rest of the column outputs are kept in tri–state to allow dual keypad activation to be detected. After that the keyboard scanning is completed and no activity is found the MCU writes ”0” to all columns, enables the keyboard interrupt and enters sleep mode where the clock to the MCU is stopped. A key press will again start up the MCU.

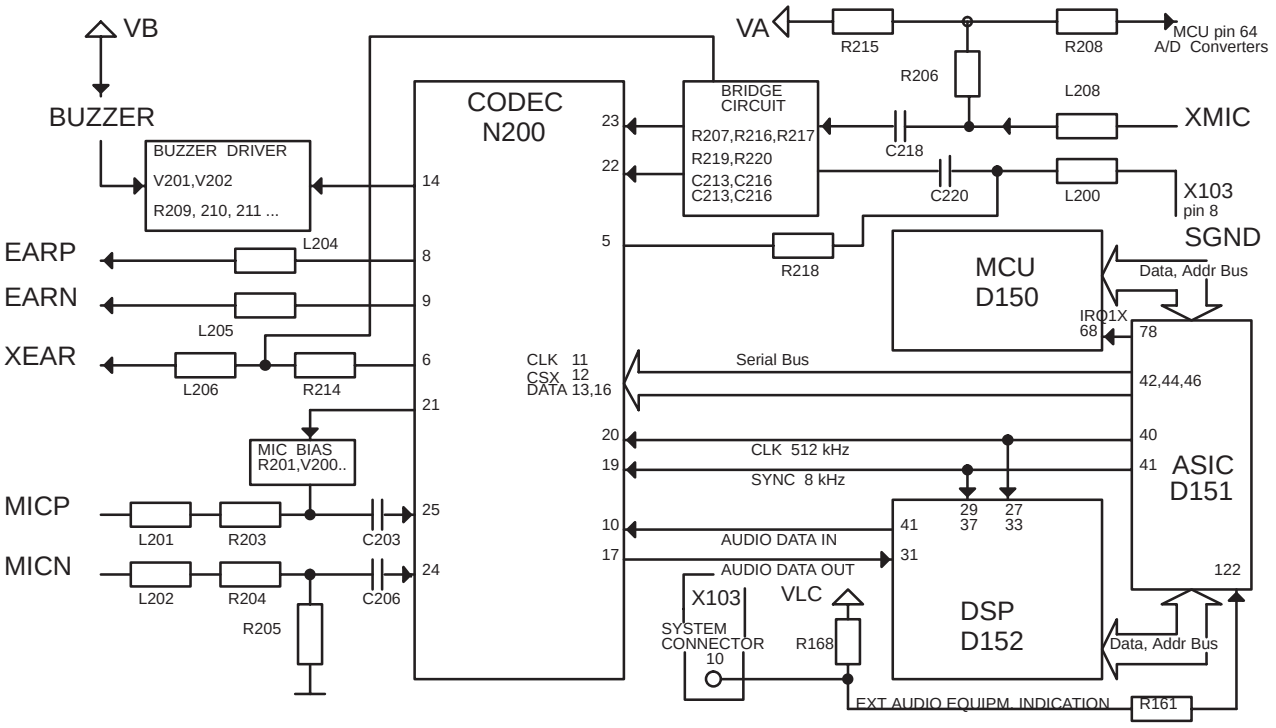
Keyboard and Display Light

The display and keyboard are illuminated by LED’s. The light is normally switched on when a keypad is pressed. The rules for light switching are defined in the SW UI specifications. The display and keyboard light is controlled by the MCU. The LED’s are connected two in series to reduce the power consumption. Due to the amount of LED’s required for the keyboard and display light they are divided into three groups. Each group has it’s own control transistor. The LED switch transistor is connected as a constant current source, which means that the current limiting resistor is put in the emitter circuitry. This arrangement will reduce LED flickering depending upon battery voltage and momentary power consumption of the phone. The LED’s are connected straight to the battery voltage. This connection allows two LED’s to connected in series. The battery voltage varies a lot depending upon if the battery is charged, full or empty. The switching transistor circuitry is designed to improve this as mentioned earlier.

The LED transistor control lines are coming from PSCLD. The MCU controls these lines by writing to PSCLD using the serial control bus. There are two LED control lines provided by the PSCLD. The display light control is connected to a separate control line. The keyboard light control is common to the two transistors. This means that the keyboard and display light can be controlled separately. The advantage of this is that the power dissipation and heating of the phone can be reduced by only having the required lights switched on.

Audio Control

The audio codec N200 is controlled by the MCU, D150. Digital audio is transferred on the CODECB(5:0). PCM data is clock at 512 kHz from the ASIC and the ASIC also generates 8 kHz synchronization signal for the bus. Data is put out on the bus at the rising edge of the clock and read in at the falling edge. Data from the DSP, D152 to the audio codec, N200 is transmitted as a separate signal from data transmitted from the audio codec, N200 to the DSP, D152. The communication is full duplex synchronous. The transmission is started at the falling edge of the synchronization pulse. 16 bits of data is transmitted after each synchronization pulse.



The 512 kHz clock is generated form 13 MHz using a PLL type of approach which means that the output frequency is not 512 kHz at any moment. The frequency varies as the PLL adjusts the frequency. The average frequency is 512 kHz. The clock is not supplied to the codec when it is not needed. The clock is controlled by both MCU and DSP. DTMF tones are generated by the audio codec and for that purposes the 512 kHz clock is needed. The MCU must switch on the clock before the DTMF generation control data is transmitted on the serial control bus.

The serial control bus uses clock, data and chip select to address the device on the bus. This interface is built in to the ASIC and the MCU writes the destination and data to the ASIC registers. The serial communication is then initiated by the ASIC. Data can be read form the audio codec, N200 via this bus.

Internal Audio

The bias for the internal microphone is generated from the PSCLD, N301 analog output, VA using a bias generator. The bias generation is designed in such a way that common mode signals induced into the microphone capsule wires are suppressed by the input amplifier in the audio codec. The bias generator is controlled by the MCU to save power, the control signal is taken from the audio codec, N200 output latch, pin 21, when the microphone is not used, in idle the bias generator is switched off. The microphone amplifier gain is set by the MCU to match with the used microphone, 35 dB. The microphone amplifier input to the audio codec is a symmetrical input.

The microphone signal is connected to the baseband using filtering to prevent EMC radiation and RF PA signal to interfere with the microphone signal. L201

and C201 forms the first part of this filter. R203 and C202 forms the second part of this filter. A similar filter is used in the negative signal path of the microphone signal. R205 is connected in the ground path for the microphone bias current. R202 supplies the bias current to the microphone from the generator circuitry R201, C200 and V200. A transient suppressor, V204, is connected across the microphone terminals to protect the microphone against ESD.

The earpiece amplifier used for the internal earpiece is of differential type and is designed as a bridge amplifier to give the output swing for the required sound pressure. Since the power supply is only 3V a dynamic type ear piece has to be used to achieve the sound pressure. This means that the ear piece is a low impedance type and represents a significant load to the output amplifier. Series inductors are implemented to prevent EMC radiation from the connection on baseband to the earpiece. The same filter also prevents the PA RF field from causing interference in the audio codec, N200 output stage to the earpiece.

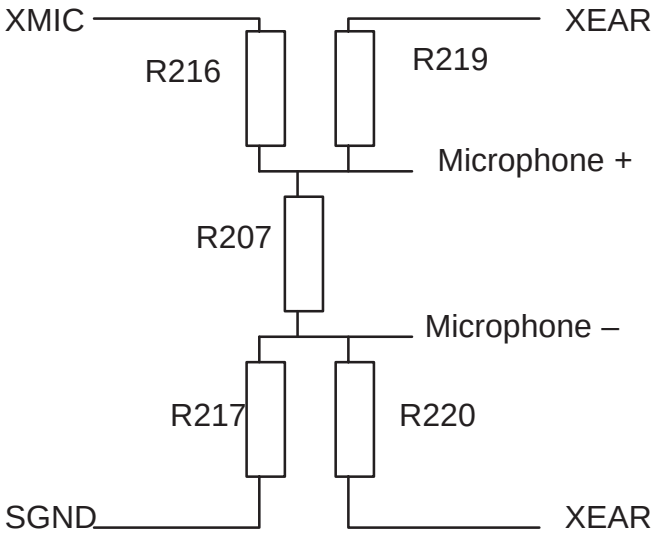
The buzzer is controlled by the PWM output provided by the audio codec, N200. Transistors V201 and V202 acts as amplifier and, impedance conversion for the low impedance buzzer. The buzzer is driven directly from the battery voltage. As the buzzer is connected to the baseband via the keyboard the battery voltage provided by VBKEY and the buzzer driving signal BUZZER are EMC protected. As the buzzer is a dynamic one the impedance shows a clear inductance. Therefore a free running diode V203 is used to clip the voltage spikes induced in the buzzer line when the buzzer is switched off.

The buzzer frequency is determined by the internal setup of N200. The frequency is determined by the MCU via the serial control bus. The output level can be adjusted by the PWM function which is attached to the buzzer output in N200.

External Audio

The external microphone audio signal is applied to the baseband system connector and connected to the audio block using signals XMIC and SGND. In order to improve the external audio performance the input circuitry is arranged in a sort of dual ended. A wheatstone type of bridge configuration is created by resistors R216, R217, R219 and R220. The signal is attenuated around 20 dB to not cause distortion in the microphone amplifier. The microphone signal is attenuated by resistors R216, R207 and R217. Two allow the external earpiece to be driven dual ended the external microphone signal ground is connected to the negative output of the external audio earpiece amplifier. This means that with reference to audio codec, N200 ground there is a signal level on the SGND line. This arrangement requires that the external microphone amplifier supplies the signal on the SGND line to the XMIC line. With this arrangement the differential voltage over R207 caused by the signal in the SGND line is canceled. There is however a common mode component which is relatively high presented at both the external microphone input pins at the audio codec input, pins 22 and 23. The microphone amplifier has a good common mode rejection ratio but a slight phase shift in the signals will remove the balance. To compensate

for this the signal from the external earpiece amplifier positive output, which also feeds the external audio output from the baseband is feed to the remaining resistors in the bridge, R219 and R220. This arrangement will attenuate the common mode signal presented to the microphone amplifier caused by the audio signal in the SGND line. Since the positive output from the audio codec, XEAR signal introduces a DC signal to the microphone amplifier the DC signal on the XMIC and SGND lines are blocked by capacitors C218 and C220.



The external audio output is the XEAR signal on the system connector pin. The XEAR signal is taken from audio codec N200 pin 6. The output impedance is increased to 32 ohms by resistors R222 and R214. This resistors prevents the output amplifier from being short circuited even if the pin at the system connector is short circuited. An ESD capacitor, C225, is connected to ground at the connection point of R222 and R214. R222 is added to N200 pin 6 output as the output amplifier can not be loaded directly with the ESD capacitor. The DC voltage at the XEAR output is used to control the mute function of the accessory. When internal audio is selected the XEAR amplifier in N200 is switched off and the DC voltage at the output on pin 5 is removed. External audio output level is adjusted by the variable gain amplifier in the N200 by MCU via the serial control bus from the ASIC, D151. L206 and C 214 is EMC protection for the XEAR signal at the system connector. This filter also prevents RF signals induced in the external cables from creating interference in the audio codec output stage.

DSP

The DSP used in NHE–5 is the TI 320C541. This is a 16 bit DSP that can use external and/or internal memory access. The DSP can operate in two modes microprocessor mode or microcontroller mode. The difference between the two modes are that in microprocessor mode the DSP boots from external memory while in the microcontroller mode the DSP boots from internal ROM. The DSP external memory access is devided into data, program and I/O access. The type of access is indicated on three control pins that can be used for memory control.

The DSP, D152 executes code from the internal ROM. The baseband also provides external memories for the DSP, D410, D411. The DSP is capable of addressing 64 kword of memory. The memory area is divided into a code execution area and a data storage area. The code execution area is located at address 8000H–FFFFH in the internal ROM. The external memories are arranged in such a way that the DSP can access the external memories both as data storage and code execution. The memory chip select is taken from the memory access strobe signal from the DSP. This means that the memory is active during any memory access. The SRAMs are configured in chip select controlled write mode. This means that both the write signal and the output enable signal are active at the same time, and the actual write occours at the rising edge of the chip select signal. This implementation is required since the DSP supports only one signal for write/read control.The DSP, D152 executes code from the internal ROM. The baseband also provides external memories for the DSP, D410, D411. The DSP is capable of addressing 64 kword of memory. The memory area is divided into a code execution area and a data storage area. The code execution area is located at address 8000H–FFFFH in the internal ROM. The external memories are arranged in such a way that the DSP can access the external memories both as data storage and code execution. The memory chip select is taken from the memory access strobe signal from the DSP. This means that the memory is active during any memory access. The memories are connected in such a way that the write control is CE controlled write. This means that both the write signal and the output enable signal are active at the same time. This implementation is required since the DSP supports only one signal for write/read control.

The DSP is operating from the 13 MHz clock. In order to get the required performance the frequency is internally increased by a PLL by a factor of 3. The PLL requires a settling time of 50 us after that the clock has been supplied before proper operation is established. This settling counter is inside the DSP although the ASIC, D151 contains a counter that will delay the interrupt with a programmable amount of clock cycles before the interrupt causing the clock to be switched on is presented to the DSP. The DSP has full control over the clock supplied to it. When the DSP is to enter the sleep mode the clock is switched off by setting a bit in the ASIC register. The clock is automatically switched on when an interrupt is generated.

The DSP also has two synchronous serial channels for communication. One channel is used for data transmission between the DSP and the audio codec. This channel is operating at 512 kbits and clock and synchronization signal is provided by the ASIC, D151. The other channel is used for debugging purposes and uses the same clock and synchronization signals. The DSP has an interrupt controller servicing four interrupts and one non maskable interrupt, NMI. The interrupts have fixed priority which can only be changed by changing the interconnection between the interrupt sources by HW.

The ASIC contains DSP support functions as modulator,encryption/decryption using algorithms A5/A51, RF power ramp generation/AGC control, AFC control, Synthesiser serial interface, frame counters, timer, RFI2 interface, RX and TX

power control timing. RF power ramp timing/AGC control, AFC control, synthesiser control are timed to the value of the frame counter. This means that data is loaded into the registers and transferred when the frame counter and the reference value matches. This allows timing of synthesiser control power ramp and start of TX data to be controlled very precisely.

As the receiver and the transmitter is not operating at the same time the TX power ramp function is used to control the AGC in the receiver during the reception. This requires the DSP to continously modify the values in the TX ramp SRAM to fit the ramp during TX and the AGC value during reception.

DSP ASIC Access

The DSP is accessing the ASIC in the DSP I/O area. 2 wait states are required for the ASIC access. Some of the DSP registers located in the ASIC are retimed to the internal ASIC clock and requires special handling with respect to consecutive writing. This means that the same register can not be written again until a specified time has passed. To cope with this DSP is inserting NOP instructions to satisfy this requirement.

DSP Interrupts

The DSP supports 4 external interrupts. Three interrupts are used. The ASIC, D151 generates two of the interrupts. One interrupt is generated by RFI2, N450 auxiliary A/D converter. This interrupt is generated when a baseband measurement A/D conversion is completed. The interrupts to the DSP are active low.

INT0 which is the highest priority interrupt is used for data reception from the receiver and is generated by the ASIC. INT1 signal is used for auxiliary A/D channel conversions generated by the RFI2. This interrupt is generated by RFI2 and is a result of measurement requests from the DSP. There are 8 auxiliary channels supported by the RFI2, not all are used in HD842 even if most of the channels are connected. INT3 is a low priority interrupt generated by the ASIC timer. The DSP programs the timer value and an interrupt is given when the timer expires. The interrupt must be active at least 1 ??? DSP clock cycle as it is sampled on the rising/falling edge by the DSP. All interrupts are active low.

INT0 is used for the reveiver A/D converter in RFI2. The ASIC reads the data from the receiver path A/D converter in RFI2 at every data available signal activation from the RFI2. After the data transfer when the data is stored in the ASIC the ASIC generates a receiver interrupt to the DSP using INT1 signal. The DSP enters the interrupt routine and services the interrupt and reads the data from the ASIC.

INT1 signal is used for the auxiliary A/D converter channels in RFI2. These A/D channles are used for baseband battery voltage monitoring. Two channels are used for battery monitoring. The start of the A/D conversion task is timed in such a way that auxiliary channel 1 results are measured during transmission whne the PA is active and channel 8 is measuring when the PA is off.

Unused interrupt controller inputs are tied high.

DSP Serial Communications Interface

The DSP contains two synchronous serial communications interface. One of the interfaces are used to communicate with the audio codec, N200. The 512 kHz clock required for the data transfer is provided by D151 as well as the 8 kHz synchronization signal. Data is transferred on to lines, RX and TX creating a full duplex connection. Data is presented on the bus on the first rising edge of the clock after the falling edge of the synchronization pulse. Data is read in by each device on the falling edge of the clock. Data transfer is 16 bits after each synchronization pulse.

The DSP, D152 has control over the clock provided to the audio codec. The DSP can switch on the clock to start the communication and switch it off when it is not needed. This clock is also under control of MCU, D150.

RF Synthesizer Control

The synthesizer control is performed by the DSP, D152 using the ASIC, D151 as the interfacing and timing device. Different synthesizer interface are supported and the required interafce can be selected by the DSP at the initialisation stage of the ASIC. The synthesizer interface also includes timing registers for programming synthesizer data. The DSP loads the synthesizer data into the transmission registers in the ASIC synthesizer interface together with the timing information. The system timing information is used for synthesizer data loading. When the system timing register, frame counter, value matches with the timing value programmed into the synthesizer interface the interface transmits the loaded data to the RF synthesizer and the VCO frequency is changed accordingly. As the synthesizer may be powered off when not needed the interface pins towards the synthesizer can be put in tri–state or forced low when the interface is not active.

RFI2, N450 Operation

The RFI2, N450 contains the A/D and D/A converters to perform the A/D conversion from the received signal and the D/A converters to perform the conversion for the modulated signal to be supplied to the transmitter section. In addition to this the RFI2 chip also contains the D/A converter for providing AFC voltage to the RF section. This AFC voltage controls the frequency of the 13 MHz VCXO which supplies the system clock to the baseband. The RFI2, N450 also contains the D/A converter to control the RF transmitter power control. The power control values are stored in the ASIC, D151 and at the start of each transmission the values are read from the ASIC, D151 to the D/A converter producing the power control pulse. This D/A converter is used during the reception to provide AGC for the receiver RF parts.

The RFI2 contains the interface between the baseband and the RF. RFI2 circuit contains the A/D converters required for the receiver and the D/A converters

required for the transmission. In addition to this the RFI2 contains a 10 bit D/A convereter for AFC control and one of the receiver A/D converters has a multiplexed input for 8 additional channels used for baseband monitoring functions. The A/D converters are 12 bit sigma delta type. This means that the digital output is centered around the reference voltage and the output value is both negative and positive. The RFI2 has an internal reference voltage for the A/D and D/A converters that can be switched off to save power. The reference has external filtering capacitors to improve the converter performance. The transmitter D/A converters are followed by interpolator and post filter. The filter is of switch capacitor type and the filter parameters are taken into account when modulator parameters are calculated. The AFC D/A converter is static and requires no clock for operation. This means that the RFI2 clock can be switched off and the AFC value will be kept.

One of the A/D converters used for receiver signal conversion can be used as an auxiliary converter that supplies 8 channels for baseband measurement purposes. When the converter is used in this mode each conversion generates an interrupt directly to the DSP. The DSP operates this converter via the ASIC, D151.

Data communication between the ASIC, D151 and RFI2, N450 is carried out on a 12 bit parallel data bus. The ASIC, D151 uses 4 address lines to access RFI2, N450. Depending on the direction of the communication either the write control signal is used to write data to RFI2, N450 or the read signal is used to read data from RFI2, N450. The ASIC, D151 supplies 13 MHz clock to the RFI2, N450. This clock is used as reference for the A/D and D/A converters. Communication between the ASIC, D151 and the RFI2, N450 is related to the clock.

The signal from the RF receiver is attenuated at the RFI2 converter input. R454 forms together with the output impedance from the receiver section an attenuator for the input signal to N450. This attenuator is symmetric as it is connected between the two input signals, improving the S/N compared to an attenuator towards ground.The attenuation is done in a symmetric way by series resistors and a resistor between the two inputs. The benefit of this is that the attenuator ground noise is removed and the bias voltage error between the two inputs are reduced. This also affects the settling time in case the analogue supply to RFI2 is switched off. The settling time is reduced due to this attenuator.

The auxiliary channels supported by the RFI2 uses one of the receiver A/D converters as the A/D converter. Due to the type of converter used for the receiver converters the value read from the auxiliary channels can be negative. The input voltage applied to the auxiliary channels must be within 0.5–3.0 V. A 12 bit value is received from the auxiliary channel measurement. The auxiliary channel conversion complete is sent direct to the DSP as an interrupt, INT1. The DSP reads the value using direct access through the ASIC to the RFI2 converter. The conversion is started by the DSP writing the address of the channel to be measured to the ASIC register. The ASIC then writes the selected channel to RFI2 and the conversion is started. The DSP may sample the same channel for more than one value as the A/D converter will produce conti-

nuosly new values. Several samples may be used for example in battery voltage measurement to calculate an avarage value from the results.

The RFI2, N450 digital supply is taken from the baseband main digital supply. The analog power supply, 4.5V is generated by a regulator supplied from the RF section. The external transistor required for the regulator is provided by the baseband, V450. The analog power supply is always supplied as long as the baseband is powered, if R342 is assembled. The RFI2, N450 analog power supply can be switched off during sleep by removing R342 and adding R349. In this case the RFI2, N450 analog power supply is in the control of the PSCLD, N301 sleep control signal.

Receiver Timing and AGC

RF receiver power on timing is performed by the ASIC, D151. The DSP, D152, can program the time when the receiver is to be powered on. The timing information is taken from the system timing that is based upon the frame counter inside the ASIC, D151 which is synchronised to the base station carrier frequency using AFC to tune the receiver. As transmission and reception takes place at different time the D/A converter used for transmitter power control is used to control the AGC of the receiver during reception. This requires the DSP, D152 to alter the content of the SRAM containing the information that is written to the D/A converter for the reception and the transmission.

RF Transmitter Timing and Power Control

The RF Power Amplifier (PA) timing control is performed by the ASIC, D151. The power control is performed by the ASIC D151 using the D/A converter in N450. The ASIC, D151 controls the power supply voltage to the RF transmitter sections. As the first step the relevant circuits are powered on using the TX power control output from the ASIC, D151. The timing for powering on the TX circuits is generated from the ASIC internal system timing circuitry, frame counter. As the RF TX circuitry needs time to stabilize after power on before the actual transmitter can be started there is a programmable delay before the ASIC, D151 starts to write the power ramp data to the D/A converter inside N450. The TXC signal which is generated in this way controls the power ramp of the PA and the power level for that burst. At the end of the burst the power ramp is written to the D/A converter inside N450. The data that creates the power ramp and final power level is stored in a SRAM inside the ASIC, D151. At the start of the ramp the contents of the SRAM is read out in increasing address order. At the end of the ramp the contents is read out in decreasing adress order. The power level during the burst is determined by the last value in the SRAM, this value is the value that will remain in the D/A converter during the burst. The DSP, D152 may change the shape of the falling slope of the poer ramp by writing new values to the power ramp SRAM during the burst.

As the transmitter may have to adjust the transmitter burst due to the distance from the base station there is an additional timer for this purpose. This timing is

called the timing advance and will cause the transmission to start earlier when the distance to the base station increases.

SIM Interface

The SIM interface is the serial interface between the smart card and the base-band. The SIM interface logic levels are 5V since no 3V technology SIM is yet available. The baseband is designed in such a way that a 3V technology SIM can be used whenever it is available. The SIM interface signals are generated inside the ASIC. The signals coming from the ASIC are converted to 5V levels. The PSCLD circuit is used as the logic voltage conversion circuit for the SIM interface. The PSCLD circuit also contains the voltage regulator for the SIM power supply. The control signals from the ASIC to PSCLD are at 3V level and the signals between PSCLD and the SIM are 5V levels. An additional control line between the ASIC and the PSCLD is used to control the direction of the DATA buffer between the SIM and the PSCLD. In a 3V technology environment this signal is internal to the ASIC only. The pull up resistor required on the SIM DATA line is integrated into the PSCLD and the pull–up is connected to the SIM regulator output inside PSCLD. In idle the DATA line is kept as input by both the SIM and the interface on the base band. The pull–up resistor is keeping the DATA line in it's high state.

The power up and power down sequences of the SIM interface is performed according to ISO 7816–3. To protect the card from damage when the power supply is removed during power on there is a control signal, CARDIN, that automatically starts the power down sequence. The CARDIN information is taken from the battery size indicator signal, BSI, from the battery connector. The battery connector is designed in such a way that the BSI signal contact is disconnected first, while the power is still supplied by the battery, and the battery power contacts are disconnected after that the battery pack has moved a specified distance.

Since the power supply to the SIM is derived from PSCLD also using 3V technology SIM the power supply voltage of the SIM regulator is programmable 3.15/4.8 V. The voltage is selected by using the serial control bus to PSCLD. The default value is set to 3.2V nominal.

For cross compatibility reasons the interface should always be started up using 5V. The 3V technology SIM will operate at 5V but a 5V SIM will not operate at 3V. The supply voltage is switched to 3V if the SIM can accept that. The SIM has a bit set in a data field indicating it's capability of 3V operation.

The regulator control signal is derived from the ASIC and this signal controls the operation of the SIM power supply regulator inside PSCLD. To ensure that the powered off ASIC doesn't cause any uncontrolled operations at the SIM interface the PSCLD signals to the SIM are forced low when the PURX signal is active, low. This implementation will ensure that the SIM interface can not be activated by any external signal when PSCLD has PURX active. When PURX goes inactive the control of the interface signals are given back to the ASIC signals controlling PSCLD SIM interface operations.

The clock to the SIM can be switched off if the SIM card allows stopping of the clock. The clock can be stopped either in high or low state, determined by the card data. For cards not allowing the clock to be stopped there is a 1.083 MHz clock frequency that can be used to reduce the power consumption while the clock is running. In this case the VCO must be running all the time. When the clock is stopped and the status of the CARDIN signal changes, battery is removed, the clock to the SIM is restarted inside the ASIC and the SIM power down sequence is performed.

To be able to handle current spikes as specified in the SIM interface specifications the SIM regulator output from PSCLD must have a ceramic capacitor of 100 nF connected between the output and ground close to the SIM interface connector. To be able to cope with the fall time requirements and the disconnected contact measurements in type approval the regulator output must be actively pulled down when the regulator is switched off. This active pull–down must work as long as the external battery is connected and the battery voltage is above the PSCLD reset level.

The SIM power on procedure is controlled by the MCU. The MCU can power up the SIM only if the CARDIN signal is in the inactive state, low. Once the power up procedure has been started the ASIC takes care of that the power up procedure is performed according to ISO 7816–3.

The SIM interface uses two clock frequencies 3.25 MHz or 1.625 MHz during SIM communication. The data transfer speed in the SIM GSM session is specified to be the supplied clock frequency/372. The ASIC SIM interface supplies all the required clock frequencies as well as the required clock frequency for the UART used in the SIM interface data transmission/reception.

SIM Interface and Support in D151

The signal from the BSI input from the battery is fed to D151, pin 25. This pin has a special input cell that has specific input levels to convert the BSI signal into the card detection logical control signal for the SIM interface in the ASIC. When the input voltage has been low, less than 1.5V the output from the cell will remain low until the input voltage exceeds 2.3V. If the input voltage has been more than 2.8V the input will remain high until the input voltage has decreased to at least 1.9V. For all specified battery types the BSI voltage will stay below 2.3V. If the voltage on this pin exceeds 2.3V the card detection signal will be active and the card will be powered down. It is not possible to power up the card as long as the card detection signal is active, high.

BART ASIC

Display Driver Interface

The display driver used is Seiko SD1232. The display driver has internal voltage triple circuitry for LCD voltage generation. Capacitors C266 and C267 are used in the voltage converter. Capacitor C 268 is the filtering capacitor for the

voltage generator output. Capacitors C261–C264 are filtering capacitors for the supply voltage to the display driver back plane voltages. Resistor network R271 and R272 forms the feedback network for setting the contrast for the display.

The HD842 Base Band uses a serial interface to the Seiko LCD driver. The serial interface is designed in the ASIC. The MCU writes data into the serial interface in the ASIC and it is then transmitted to the LCD driver. The LCD driver reset is controlled by the MCU on P40. The display driver reset is dual edge active. The P40 pin on the MCU has a pull down resistor, R166 to ensure that the LCD driver reset is low at power up. After exiting reset one of the first tasks for the MCU is to set the P40 to output and low, ”0”. After at least 100 us the reset signal to the display driver is taken high, ”1”. This rising edge reset selects 80XX type MCU interface. The serial interface setting of the driver will override this. After resetting the display driver the MCU starts the initialization procedure using the serial interface in the ASIC, D151.

Communication with the serial driver takes place on the LCDSIOCONB(5:0). The display driver requires serial data, serial clock and command/display information during the serial transfer. The display driver has it’s own chip select which is active during the transfer, there are other devices on the same serial bus as well. The command/display information is transmitted on the keyboard ROW5 output. Due to the fact that the keyboard interface is used during display driver transfers the keyboard activities must be disabled during display driver communication. This means that the column output from the ASIC must be put in high impedance state not to interfere with the data transmission if keypads are pressed.

The timing required for the serial interface is provided by the ASIC and the operation of ROW5 depends upon the display driver interface initialization. For the serial interface it is used for command/display data control. The serial clock is 541 kHz.

The clock to the display driver interface in the ASIC is automatically switched on when a write operation to the interface has taken place. The MCU can force the clock to be continuously on by writing the clock on to the CTSI block. The default assumption is that the MCU forces the clock to be continuously on only when a large amount of data is to be transmitted, such as segment test at power up.

RF Block

Introduction

The RF module carries out all the RF functions of the transceiver. This module works in the GSM system.

Components are located on both sides of the PWB. All components with height more than 2 mm are on side two and lower than 2 mm components are on both sides of PWB.

EMC leakage is prevented with magnesium shields. Shields conducts also heat out of the inner parts of the phone thus preventing excessive temperature rise.

Receiver

The receiver is a double conversion receiver.

The received RF signal from the antenna is fed via a duplex filter to the receiver unit. The signal is amplified by a discrete low noise preamplifier. The gain of the amplifier is controlled by the AGC control line (PDATA0). The nominal gain of 16.5 dB is reduced in the strong field condition about 36 dB. After the preamplifier the signal is filtered by SAW RF filter. The filter rejects spurious signals coming from the antenna and spurious emissions coming from the receiver unit.

In GSM systems the filtered RF–signal is down converted by the passive diode mixer. The first IF frequency is 71 MHz in GSM. The first local signal is generated by the UHF synthesizer. The IF signals 71 MHz is amplified and filtered by SAW filter in GSM. The filter rejects adjacent channel signal, intermodulating signals and the last IF image signal.

The filtered IF signal is fed to the receiver part of the integrated RF circuit CRFRT. In CRFRT the filtered IF signal is amplified by an AGC amplifier which has gain control range of 57 dB. The gain is controlled by an analog signal via TXC line. The amplified IF signal is down converted to the last IF in the mixer of CRFRT. The last local signal is generated from VHF VCO by dividing the original signal by 4 in the dividers of CRFRT.

The last IF frequency is 13 MHz. The last IF is filtered by a ceramic filter. The filter rejects signals of the adjacent channels. The filtered last IF is fed back to CRFRT where it is amplified and fed out to RFI via RXINN and RXINP lines.

Duplex Filter

The duplex filter consists of two functional parts; RX and TX filters. The TX filter rejects the noise power in the RX frequency band and TX harmonic signals. The RX filter rejects blocking and spurious signals coming from the antenna.

Pre–Amplifier

The bipolar pre–amplifier amplifies the received signal coming from the antenna. In the strong field conditions the gain of the amplifier is reduced 36 dB in GSM, typically.

Parameter	*Value*
Frequency band:	*935–960 Mhz*
Supply voltage (min/typ/max):	*4.27...4.5...4.73 V*
Current consumption (min/typ/max):	*5...6....7 mA*
Insertion gain (min/typ/max):	*15...16.5...17 dB*
Gain flatness:	*±0.5 dB*
Noise figure (typ/max):	*2.0...2.5 dB*
Reverse isolation (min):	*15 dB*
Gain reduction (min/typ/max):	*33...36...39 dB*
IIP3: (min/typ):	*–12...–10 dBm*
Input VSWR; zo=50 Ω (max):	*2.0*
Output VSWR; zo=50 Ω (max):	*2.0*

RF Interstage Filter

The RX interstage filter is a SAW filter in GSM. The filter rejects spurious and blocking signals coming from the antenna. It rejects the local oscillator signal leakage, too.

First Mixer

The first mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer down converts the received RF signal to IF signal.

Parameter	*Value*
RX frequency range:	*935–960 Mhz*
LO frequency range:	*1006–1031 Mhz*
IF frequency:	*71 Mhz*
Conversion loss (min/typ/max):	*5...6...7 dB*
IIP3 (min/typ):	*2...5 dBm*
LO – RF isolation (min):	*15.0 dB*
LO power level (min):	*3 dBm*

First IF Amplifier

The first IF amplifier is a bipolar transistor amplifier.

Parameter	*Value*
Operation frequency:	*71 Mhz*
Supply voltage (min/typ/max):	*4.27...4.5...4.73*
Current consumption (typ/max):	*12...15 mA*
Insertion gain (min/typ/max):	*18...20...22 dB*
Noise figure (typ/max):	*3.5...4.0 dB*
IIP3 (min/typ):	*–5...–3 dBm*

First IF Filter

In GSM the first IF filter is a SAW filter. The IF filter rejects some spurious and blocking signals coming from the front end of the receiver.

Receiver IF Circuit, RX part of CRFRT

The receiver part of CRFRT consists of an AGC amplifier of 57 dB gain, a mixer and a buffer amplifier for the last IF. The mixer of the circuit down converts the received signal to the last IF frequency. After external filtering the signal is amplified and fed to baseband circuitry. The supply current can be switched OFF by an internal switch, when the RX is OFF.

Parameter	*Value*
Supply voltage (min/typ/max):	*4.27...4.5...4.73 V*
Current consumption (max):	*35 mA*
Input frequency range (min/max):	*45 MHz (–1 db point) ...87 MHz (–3 dB point)*
Local frequency range of mixer (min/max):	*42.5...100 MHz*
2nd IF range (min/max):	*2...17 MHz*
Voltage gain (max gain) of AGC amlifier (min):	*47 dB*
Noise figure (max):	*15 max gain*
AGC gain control slope (min/typ/max):	*40...84...100 dB/V*
Mixer output 1 dB compression point (typ):	*1.0 V_{PP}*
Gain of the last IF buffer:	*30*
Max output level after last IF buffer (typ):	*1.6 V_{PP}*

Last IF Filter

The last IF is 13 MHz. The ceramic filter on last IF makes part of the channel selectivity of the receiver.

Transmitter

The TX intermediate frequency is modulated by an I/Q modulator contained on transmitter section of CRFRT IC. The TX I and Q signals are generated in the RFI interface circuit and they are fed differentially to the modulator.

Modulated intermediate signal is amplified or attenuated in temperature compensated controlled gain amplifier (TCGA). The output of the TCGA is amplified and the output level is typically –10 dBm.

The output signal from CRFRT is band–pass filtered to reduce harmonics and the final TX signal is achieved by mixing the UHF VCO signal and the modulated TX intermediate signal with passive mixer. After mixing the TX signal is

amplified and filtered by amplifier and filters. These filters are dielectric filters. After these stages the level of the signal is typically 1 mW (0 dBm) in GSM.

The discrete power amplifier amplifies the TX signal to the desired power level. The maximum output level is typically 0.8...2.0 W.

The power control loop controls the output level of the power amplifier. The power detector consists of a directional coupler and a diode rectifier. Transmitted power is controlled with controlled gain amplifier (TCGA) on TX path of CRFRT. Power is controlled with TXC and TXP signals. The power control signal (TXC), which has a raised cosine form, comes from the RF interface circuit, RFI.

Modulator Circuit, TX part of CRFRT

The modulator is a quadrature modulator contained in TX section of CRFRT IC. The I and Q inputs generated by RFI interface are d.c. coupled and fed via buffers to the modulator. The local signal is divided by two to get accurate 90 degrees phase shifted signals to the I/Q mixers. After mixing the signals are combined and amplified with temperature compensated controlled gain amplifier (TCGA). Gain is controlled with power control signal (TXC). The output of the TCGA is amplified and the maximum output level is –10 dBm, typically.

Parameter	*Value*
Supply voltage (min/typ/max):	*4.27...4.5...4.73 V*
Supply current (max):	*35 mA*

Transmit frequency input	*Value*
LO input frequency (min/max):	*170...400 MHz*
LO input power level (typ):	*0.2 V_{PP}*
LO input resistance (min/typ/max):	*70...100...130 Ω*
LO input capacitance (typ):	*4 pF*

Modulator Inputs (I/Q):	*Value*
Input bias current, balanced (max):	*100 nA*
Input common mode voltage (min/typ/max):	*2.05...2.2...2.4 V*
Input level, balanced (max):	*1.1 V_{PP}*
Input frequency range (min/max):	*0...300 kHz*
Input resistance, balanced (min):	*200 kΩ*
Input capacitance, balanced (max):	*4 pF*

Modulator Output:	*Value*
Output frequency (min/max):	*85...200 MHz*
Available linear RF power (typ):	*–10 dBm, ZiL=50 kΩ*
Available saturated RF power (typ):	*0 dBm, ZiL=50 kΩ*
Total gain control range (min):	*45 dB*
Gain control slope (typ):	*84 dB/V*
Suppression of 3rd order prods (min):	*35 dB*
Carrier suppression (typ):	*35 dB*
Single sideband suppression:	
Noise floor	*–135 dBm/Hz avg.*
Transmitted I/Q phase balance: drift in whole temperature range:	*–5...5 deg* *–2...2 deg*
Transmitted I/Q amplitude balance: drift in whole temperature range:	*–0.5...0.5 dB* *–0.2...0.2 dB*

Upconversion Mixer

The upconversion mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer upconverts the modulated IF signal coming from quadrature modulator to RF signal.

Parameter:	*Value*
RX frequency range:	*860...915 MHz*
LO frequency range:	*1006...1031 MHz*
IF frequency (nom):	*116 MHz*
Conversion loss (min/typ/max):	*6.0...7.0...8.0 dB*
IIP3 (min):	*0.0 dBm*
LO – RF isolation (min):	*15 dB*
LO power level (max):	*3.0 dBm*

TX Interstage Filters

The TX filters reject the spurious signals generated in the upconversion mixer. They reject the local, image and IF signal leakage and RX band noise, too.

1st TX Buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the upconversion mixer.

Parameter:	*Value*
Operating frequency range:	*890...915 MHz*
Supply voltage (min/typ/max):	*4.25...4.5...2.8 V*
Current consumption (typ/max):	*4.5...5.0 mA*
Insertion gain (min/typ/max):	*11...12...13 dB*
Input VSWR, Zo=50 Ω (max):	*2.0*
Output VSWR, Zo=50 Ω (max):	*2.0*

2nd TX Buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the first interstage filter.

Parameter:	*Value*
Operation frequency range:	*890...915 MHz*
Supply voltage (min/typ/max):	*4.25...4.5...4.8 V*
Current consumption (typ/max):	*9.0...10.0 mA*
Insertion gain (min/typ/max):	*11...12...13 dB*
Output power, Zo=50 Ω (min/typ):	*0...3 dBm*
Input VSWR, Zo=50 Ω (max):	*2.0*
Output VSWR, Zo=50 Ω (max):	*2.0*

Power Amplifier

The power amplifier is a three stage discrete amplifier. It amplifies the 0 dBm TX signal to the desired output level. It has been specified for 6 volts operation.

Parameter:	*Value*
D.C. supply voltage, no RF (max):	*10 V*
D.C. supply voltage (min/typ/max):	*5.3...6.0...8.5 V*
Operation frequency:	*890...915 MHz*
Operating case temp. range (max):	*90 °C*
Max output power (min/typ/max):	*34.5...35...36 dBm, norm cond.*
Max output power (min/typ/max):	*33.5...34...35 dBm, extreme cond.* V_{CC}*=5.4 V, Ta=55°C*

Parameter:	*Value*
Input power (min):	*0 dBm*
Gain (min/typ/max):	*34.5...35...36 dB*
Effiency (typ):	*42 %, Po=35 dBm*
Input VSWR, Zo=50 Ω (max):	*2.0*
Output VSWR, Zo=50 Ω (max):	*2.0*
Harmonics, 2 fo: 3 fo, 4 fo, 5 fo:	*–30 dBc, Po=35 dBm* *–40 dBc, Po=35 dBm*
Noise power (max):	*–114 dBm at receiver band*
Ruggedness (min):	*8 V VSWR=7, P_{OUT}=4 W*
Stability, load VSWR 6:1 (min):	*60 dBc, all spurious*

Power Control Circuitry

The power control loop consists of a power detector and a differential control circuit. The power detector is a combination of a directional coupler and a diode rectifier. The differential control circuit compares the detected voltage and the control voltage (TXC) and controls voltage controlled amplifier (in CRFRT) or the power amplifier. The control circuit is a part of CRFRT.

Parameter:	*Value*
Supply voltage (min/typ/max): using CRFRT:	*4.5...4.7...4.9* *4.27...4.5...4.73*
Supply current (typ/max):	*3.0...5.0 mA*
Power control range (min):	*20 dB*
Power control inaccuracy (max):	*±1.0 dB*
Dynamic range (min):	*80 dB*
Input control voltage range (min/max):	*0.1...2.8 V*

Frequency Synthesizers

The stable frequency source for the synthesizers and base band circuits is discrete voltage controlled crystal oscillator, VCXO in GSM. The frequency of the oscillators is controlled by an AFC voltage, which is generated by the base band circuits. The ON/OFF switching of the oscillator is controlled by the sleep clock in the baseband via VCXOPWR.

The UHF PLL generates the down conversion signal for the receiver and the up conversion signal for the transmitter. The UHF VCO is a discrete oscillator. The working assumption for PLL circuits are from Philips UMA1018 for GSM.

The VHF PLL signal (divided by 4 in CRFR is used as a local for the last mixer. Also the VHF PLL signal (divided by 2 in CRFRT) is used in the I/Q modulator of the transmitter chain.

Frequencies; see RF frequency plan.

Referency Oscillator

In GSM the reference oscillator is a discrete VCXO and the frequency is 13 MHz. The oscillator signal is used for a reference frequency of the synthesizers and the clock frequency for the base band circuits.

Parameter:	*Value*
Centre frequency:	*13 MHz*
Frequency tolerance:	*–18....18 ppm, V_C=2.1 V*
Frequency control range:	*67 ppm*
Supply voltage (min/typ/max):	*4.275...4.5...4.725 V*
Current consumption (typ/max):	*2.5..3.0 mA*
Output voltage (min/typ/max):	*1.3...1.7...2.0 V_{PP}, sine wave for PLLs*
Harmonics (max):	*5 dBc*
Control voltage range (min/max):	*0.3...3.9 V*
Nominal voltage for centre frequency:	*2.1 V*
Control sensitivity (min/typ/max):	*12...18...25 ppm/V*
Frequency stability	
• temperature:	*10 ppm, –25...+75 °C*
• supply voltage:	*1 ppm, 4.7 V ±5 %*
• load:	*0.1 ppm, load ±10 %*
• aging:	*1 ppm, year*
Operating temperature range (min/max):	*–20...70 °C*
Load impedance, resistive part:	*2 kΩ*
parallel capacitance:	*20 pF*

VHF PLL

The VHF PLL consists of the VHF VCO, PLL integrated circuit and loop filter. The output signal is used for the 2nd mixer of the receiver and for the I/Q modulator of the transmitter.

Parameter:	*Value*
Start up setting time (max):	*5 ms*
Phase error (max):	*1 deg., rms*
Sidebands (typ/max)	
• ±200 kHz:	*–75...–70 dB*
• ±400 kHz:	*–84...–70 dB*
• ±1 MHz:	*<–85...–70 dB*
• ±2 MHz:	*<–85...–75 dB*
• ±3 MHz:	*<–85...–85 dB*
• >4 MHz:	*<–85...–85 dB*

VHF VCO + Buffer

The VHF VCO uses a bipolar transistor as a active element and a combination of a chip coil and varactor diode as a resonance circuit. The buffer is combined into the VCO circuit so, that they use same collector current.

Parameter:	*Value*
Supply voltage (min/typ/max):	*4.2...4.5...4.8 V*
Control voltage (min/max):	*0.5...4.0 V*
Supply current (typ/max):	*2.5...5.0 mA*
Operation frequency (typ):	*232 MHz*
Output power level (typ):	*168 mV_{RMS}/1 kΩ*
Control voltage sensitivity (typ):	*12 MHz/V*
Phase noise (max)	
• fo ±200 kHz	*–123 dB*
• fo ±1600 kHz	*–133 dB*
• fo ±3000 kHz	*–143 dB*
Harmonics (typ/max):	*–32...–30 dB*

UHF PLL

The UHF PLL consists of a UHF VCO, divider, PLL circuit and a loop filter. The output signal is used for the 1st mixer of the receiver and the upconversion mixer of the transmitter.

Parameter:	*Value*
Start up setting time (max):	*5 ms*
Phase error (max):	*4 deg., rms*
Settling time ±93 MHz (typ/max):	*525...800 µs*
Sidebands (typ/max)	
• ±200 kHz:	*–80...–60 dB*
• ±400 kHz:	*–87...–65 dB*
• ±600 kHz:	*<–90...–70 dB*
• 1.4...3.0 MHz:	*<–90...–80 dB*
• >3.0 MHz:	*<–80 dB*

UHF VCO + Buffer

The UHF VCO uses a bipolar transistor as a active element and a combination of a microstripline and a varactor diode as a resonance circuit.

UHF VCO Buffers

The UHF VCO output signal is divided into the 1st mixer of the receiver and the upconversion mixer of the transmitter. The UHF VCO signal is amplified after division. There is one buffer for TX and one for RX.

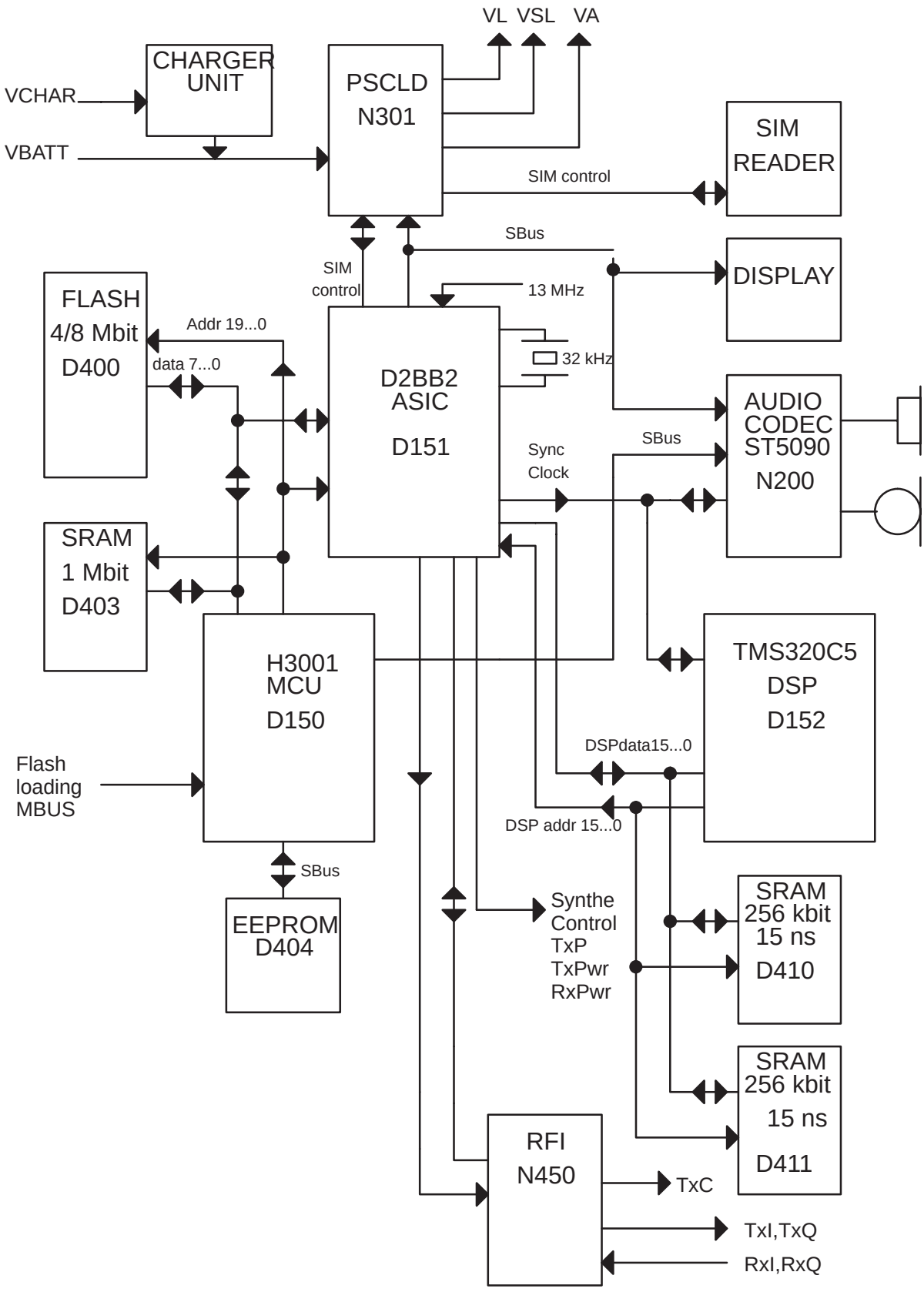
Parameter:	*Value*
Supply voltage (min/typ/max):	*4.2...4.5...4.8 V*
Supply current (typ/max):	*5.5...6.5 mA*
Input power (typ):	*–3 dBm*
Harmonics (max):	*–10 dBc*
Output amplitude (typ):	*700 mV_{RMS}/1 kΩ*

PLL Circuit

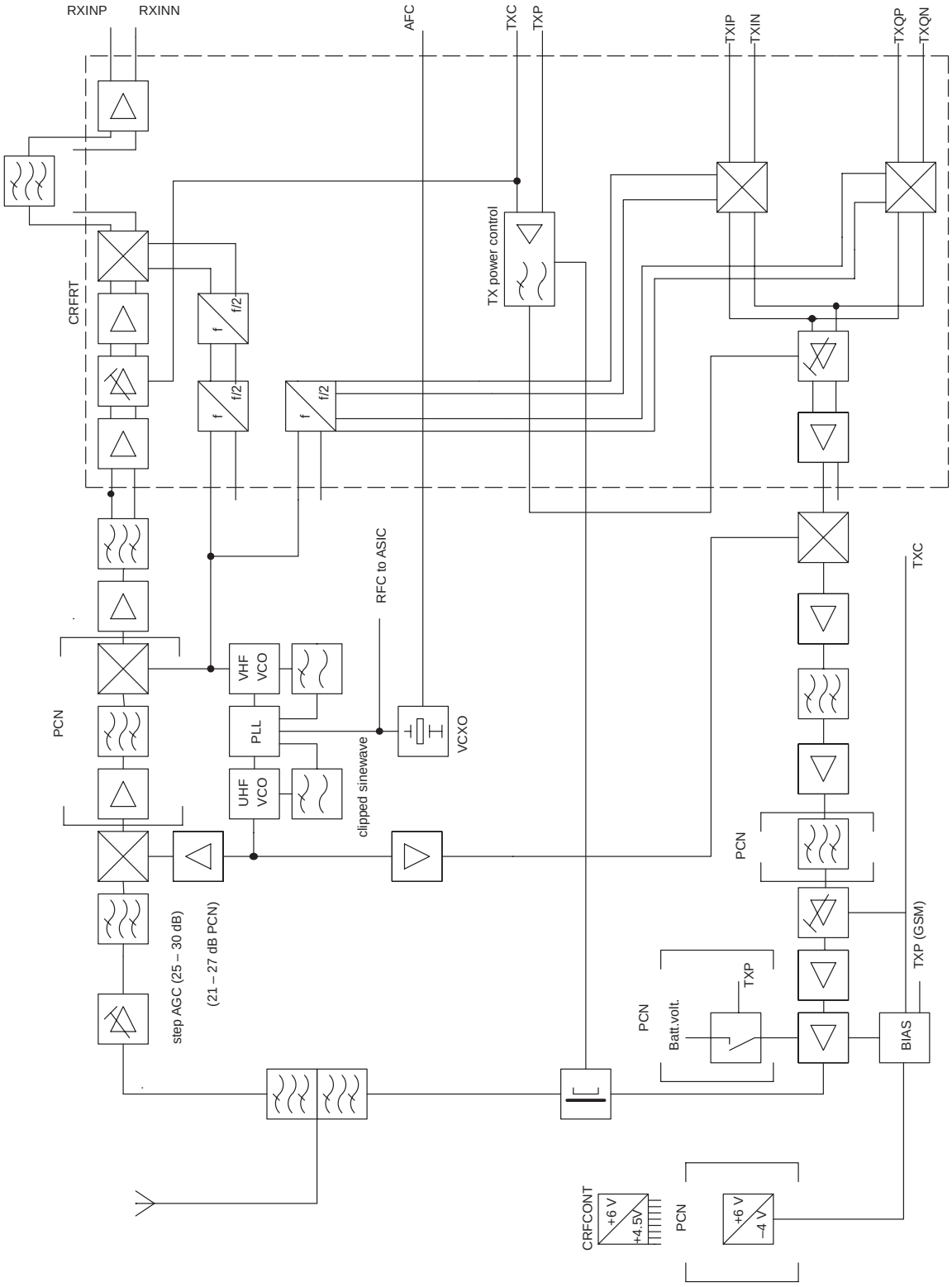
The PLL is PHILIPS UMA1018. The circuit is a dual frequency synthesizer including both the UHF and VHF synthesizers.

Parameter:	*Value*
Supply voltage (min/max):	*2.7...5.5 V*
Supply current (typ):	*8.5 mA*
Principal input frequency (min/max):	*500...1200 MHz, V_{DD} = 4.5 V*
Auxiliary input frequency (min/max):	*20...300 MHz, V_{DD} = 4.5 V*
Input reference frequency (min/max):	*3...40 MHz, V_{DD} = 4.5 V*
Input signal level (min/max):	*50...500 mV_{RMS}*

Interconnection Diagram of Baseband

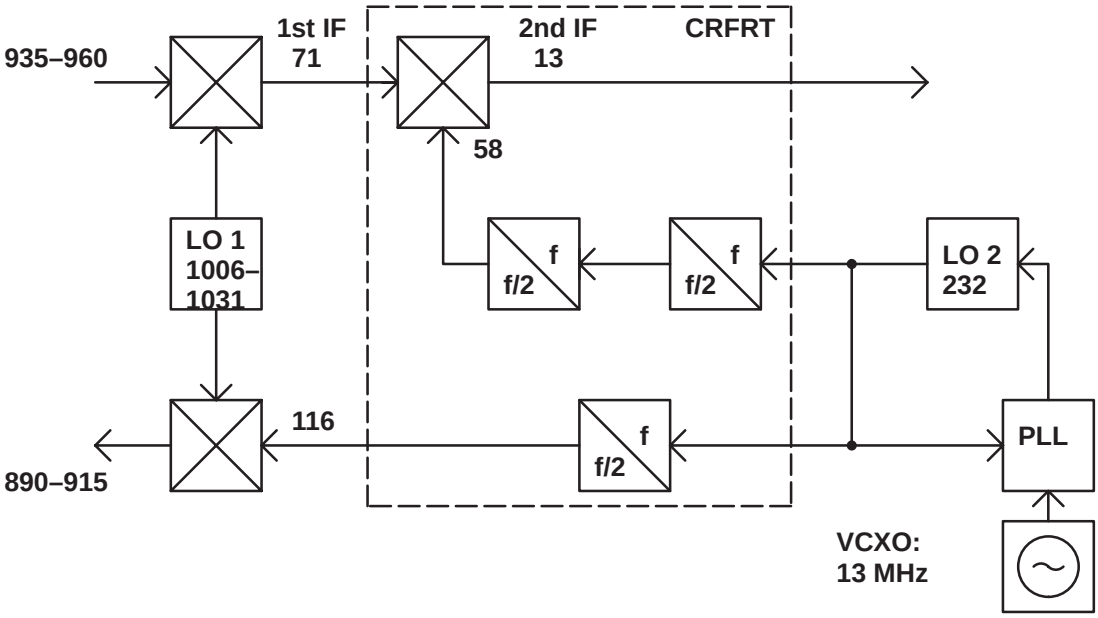


Block Diagram of RF



RF Frequency Plan

GSM



Power Distribution Diagram of RF

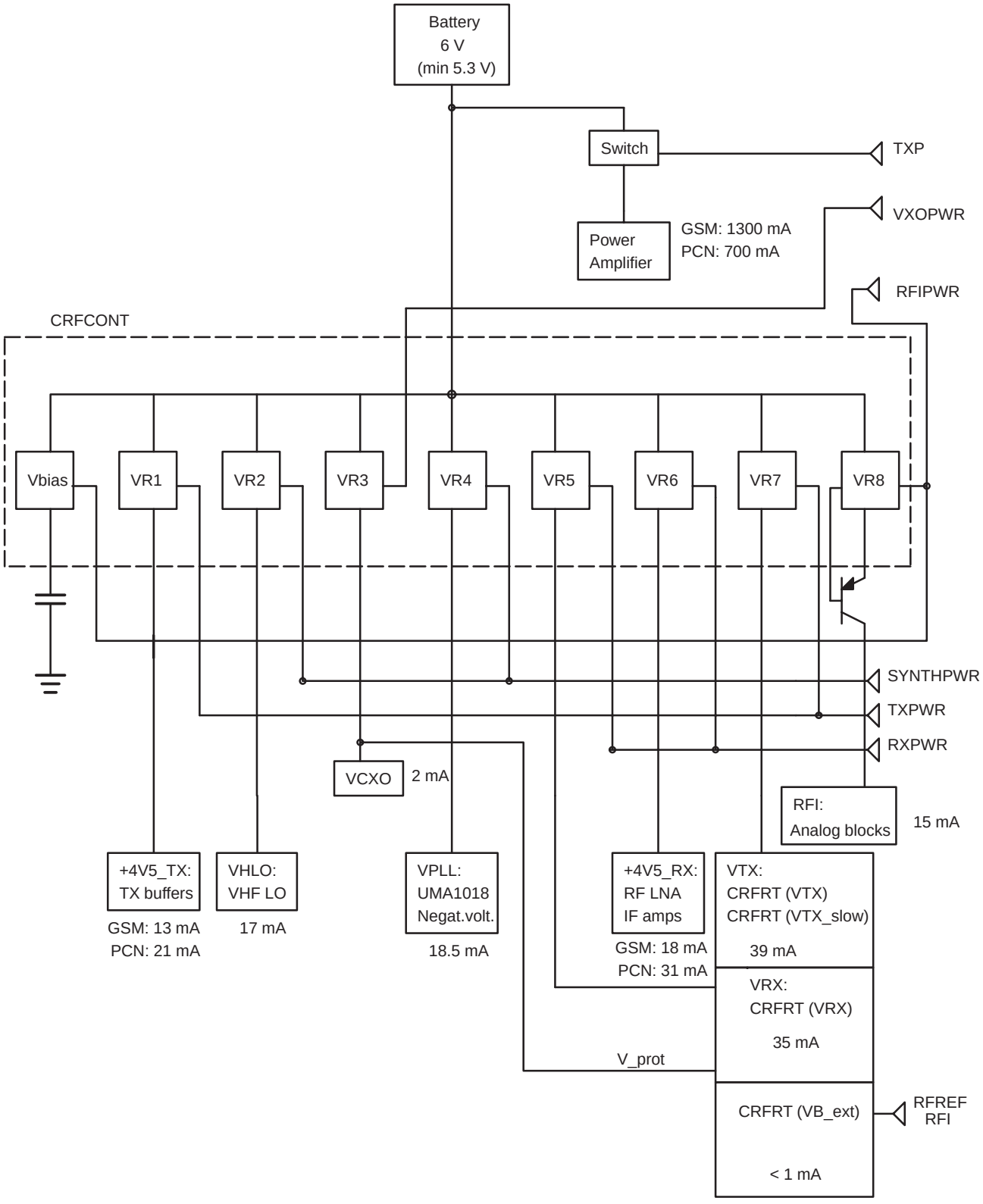
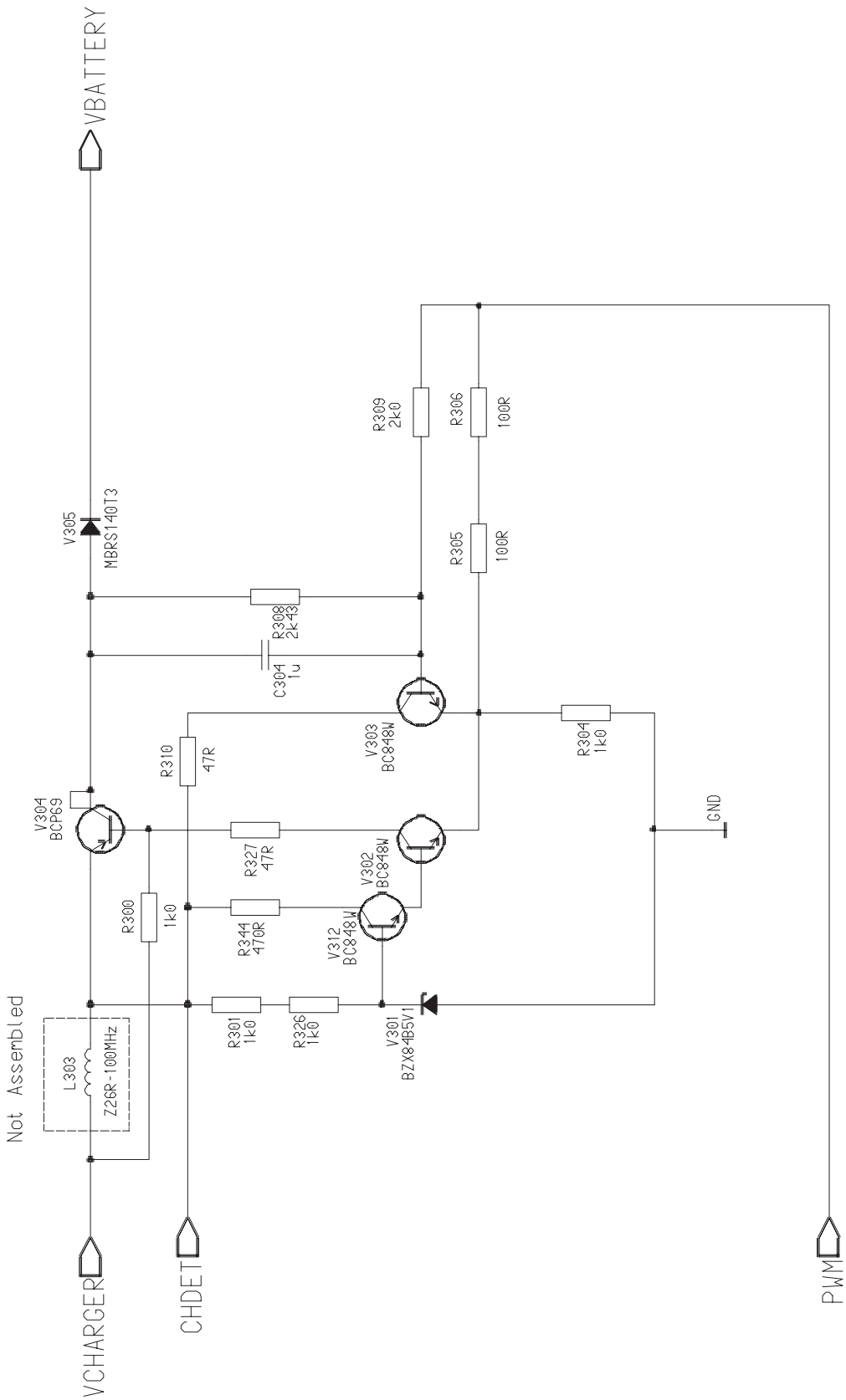
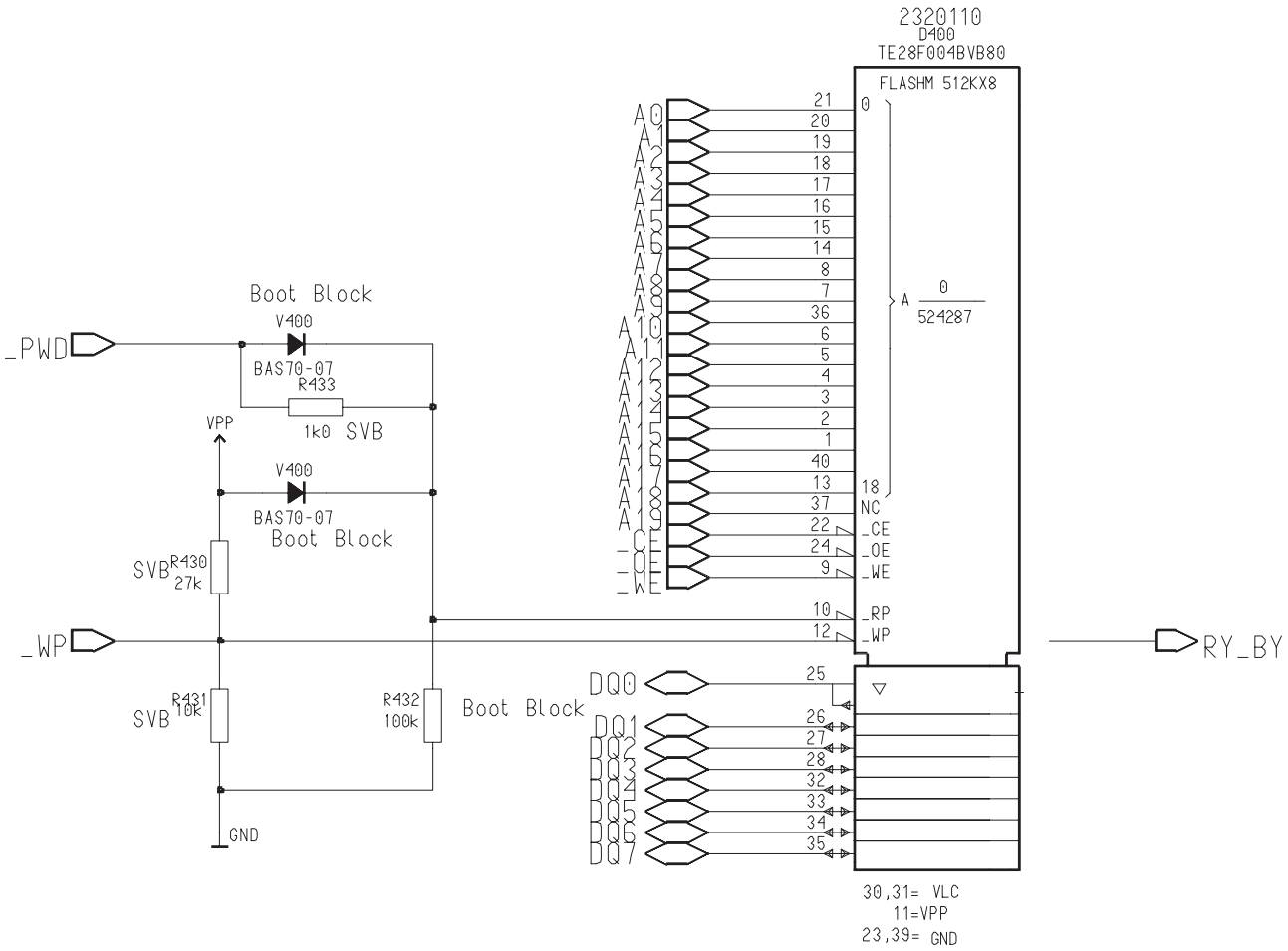


Figure 1. Power distribution diagram

Circuit Diagram of Charger Control (Version 1.0 ; Edit 15)



Circuit Diagram of 4 MBit Flash Memory (Version 3.0 ; Edit 22)



Block Diagram of Baseband

Circuit Diagram of Power Supply & Charging

Circuit Diagram of Central Processing Unit

Circuit Diagram of MCU Memory Block

Circuit Diagram of Keyboard & Display Interface

Circuit Diagram of Audio

Circuit Diagram of DSP Memory Block

Circuit Diagram of RFI

Circuit Diagram of Receiver

Circuit Diagram of Transceiver

Layout Diagrams of GT8

Layout Diagrams of GT8

Parts list of GT8 (EDMS Issue 4.5)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R150	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R151	1430718	Chip resistor	47	5 % 0.063 W 0402
R152	1430718	Chip resistor	47	5 % 0.063 W 0402
R155	1430726	Chip resistor	100	5 % 0.063 W 0402
R156	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R161	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R166	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R168	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R201	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R202	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R203	1430726	Chip resistor	100	5 % 0.063 W 0402
R204	1430726	Chip resistor	100	5 % 0.063 W 0402
R205	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R206	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R207	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R208	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R209	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R210	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R211	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R212	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R214	1430710	Chip resistor	22	5 % 0.063 W 0402
R215	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R216	1430029	Chip resistor	12.1 k	0.5 % 0.063 W 0603
R217	1430029	Chip resistor	12.1 k	0.5 % 0.063 W 0603
R218	1430710	Chip resistor	22	5 % 0.063 W 0402
R219	1430029	Chip resistor	12.1 k	0.5 % 0.063 W 0603
R220	1430029	Chip resistor	12.1 k	0.5 % 0.063 W 0603
R222	1430700	Chip resistor	10	5 % 0.063 W 0402
R223	1430700	Chip resistor	10	5 % 0.063 W 0402
R250	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R251	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R252	1430716	Chip resistor	39	5 % 0.063 W 0402
R253	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R254	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R255	1430724	Chip resistor	82	5 % 0.063 W 0402
R256	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R257	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R258	1430726	Chip resistor	100	5 % 0.063 W 0402
R259	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R260	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R261	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R262	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R263	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402

R264	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R265	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R266	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R267	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R268	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R269	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R270	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R271	1430061	Chip resistor	511 k	1 % 0.063 W 0603
R272	1430113	Chip resistor	348 k	1 % 0.063 W 0603
R300	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R301	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R302	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R303	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R304	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R305	1430726	Chip resistor	100	5 % 0.063 W 0402
R306	1430726	Chip resistor	100	5 % 0.063 W 0402
R307	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R308	1430027	Chip resistor	2.43 k	1 % 0.063 W 0603
R309	1430025	Chip resistor	2.0 k	1 % 0.063 W 0603
R310	1430718	Chip resistor	47	5 % 0.063 W 0402
R311	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R312	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R313	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R314	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R315	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R316	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R317	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R318	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R319	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R320	1430726	Chip resistor	100	5 % 0.063 W 0402
R321	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R322	1430726	Chip resistor	100	5 % 0.063 W 0402
R323	1430726	Chip resistor	100	5 % 0.063 W 0402
R324	1430718	Chip resistor	47	5 % 0.063 W 0402
R326	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R327	1430718	Chip resistor	47	5 % 0.063 W 0402
R328	1430726	Chip resistor	100	5 % 0.063 W 0402
R329	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R330	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R331	1430718	Chip resistor	47	5 % 0.063 W 0402
R332	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R334	1430718	Chip resistor	47	5 % 0.063 W 0402
R336	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R337	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R340	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R343	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R344	1430744	Chip resistor	470	5 % 0.063 W 0402
R345	1430804	Chip resistor	100 k	5 % 0.063 W 0402

R348	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R349	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R400	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R401	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R402	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R403	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R404	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R405	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R406	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R407	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R408	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R409	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R410	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R411	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R412	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R413	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R415	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R416	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R430	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R431	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R433	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R452	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R453	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R454	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R455	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R501	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R502	1430732	Chip resistor	180	5 % 0.063 W 0402
R503	1430732	Chip resistor	180	5 % 0.063 W 0402
R504	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R505	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R507	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R508	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R509	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R511	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R512	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R513	1430740	Chip resistor	330	5 % 0.063 W 0402
R514	1430710	Chip resistor	22	5 % 0.063 W 0402
R541	1430710	Chip resistor	22	5 % 0.063 W 0402
R542	1430734	Chip resistor	220	5 % 0.063 W 0402
R543	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R544	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R545	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R546	1430724	Chip resistor	82	5 % 0.063 W 0402
R547	1430744	Chip resistor	470	5 % 0.063 W 0402
R551	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R552	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R553	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R554	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402

R555	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R556	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R557	1430732	Chip resistor	180	5 % 0.063 W 0402
R558	1430730	Chip resistor	150	5 % 0.063 W 0402
R559	1430740	Chip resistor	330	5 % 0.063 W 0402
R560	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R562	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R566	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R570	1430726	Chip resistor	100	5 % 0.063 W 0402
R571	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R572	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R573	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R574	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R578	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R579	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R580	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R583	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R601	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R602	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R603	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R701	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R702	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R703	1430710	Chip resistor	22	5 % 0.063 W 0402
R704	1430740	Chip resistor	330	5 % 0.063 W 0402
R705	1430724	Chip resistor	82	5 % 0.063 W 0402
R708	1430690	Chip jumper		0402
R711	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R712	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R713	1430744	Chip resistor	470	5 % 0.063 W 0402
R714	1430700	Chip resistor	10	5 % 0.063 W 0402
R715	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R716	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R717	1430734	Chip resistor	220	5 % 0.063 W 0402
R725	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R726	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R727	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R728	1430730	Chip resistor	150	5 % 0.063 W 0402
R736	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R737	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R738	1430780	Chip resistor	12 k	5 % 0.063 W 0402
R739	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R740	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R741	1430746	Chip resistor	560	5 % 0.063 W 0402
R742	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R743	1430700	Chip resistor	10	5 % 0.063 W 0402
R744	1430734	Chip resistor	220	5 % 0.063 W 0402
R755	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R756	1412279	Chip resistor	2.2	5 % 0.1 W 0805

R765	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R766	1430748	Chip resistor	680	5 % 0.063 W 0402
R767	1430732	Chip resistor	180	5 % 0.063 W 0402
R768	1430752	Chip resistor	820	5 % 0.063 W 0402
R769	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R780	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R781	1430740	Chip resistor	330	5 % 0.063 W 0402
R782	1430726	Chip resistor	100	5 % 0.063 W 0402
R784	1430726	Chip resistor	100	5 % 0.063 W 0402
R785	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R800	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R801	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R802	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R803	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R804	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R805	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R806	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R807	1430760	Chip resistor	1.8 k	5 % 0.063 W 0402
R808	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R811	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R820	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R821	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R822	1430798	Chip resistor	56 k	5 % 0.063 W 0402
R823	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R824	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R825	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R826	1430780	Chip resistor	12 k	5 % 0.063 W 0402
R827	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R828	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R829	1430718	Chip resistor	47	5 % 0.063 W 0402
R830	1430726	Chip resistor	100	5 % 0.063 W 0402
R840	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R841	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R842	1430844	Chip resistor	3.9 k	1 % 0.063 W 0402
R843	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R844	1430734	Chip resistor	220	5 % 0.063 W 0402
R845	1430700	Chip resistor	10	5 % 0.063 W 0402
R846	1430726	Chip resistor	100	5 % 0.063 W 0402
R847	1430718	Chip resistor	47	5 % 0.063 W 0402
R860	1430716	Chip resistor	39	5 % 0.063 W 0402
C151	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C153	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C154	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C155	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C156	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C158	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C159	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C160	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206

C161	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C162	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C165	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C166	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C167	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C168	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C169	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C170	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C200	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C201	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C202	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C203	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C204	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C205	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C206	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C207	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C208	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C211	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C212	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C213	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C214	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C215	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C216	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C217	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C218	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C220	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C221	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C222	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C223	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C224	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C225	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C250	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C261	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C262	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C263	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C264	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C265	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C266	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C267	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C268	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C300	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C301	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C302	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C303	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C304	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C305	2604431	Tantalum cap.	10 µ	20 % 16 V 6.0x3.2x2.8
C306	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C307	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206

C308	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C309	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C310	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C311	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C312	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C313	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C314	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C315	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C316	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C317	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C318	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C319	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C320	2610153	Tantalum cap.	10 µ	20 % 6.0x3.2x2.5
C321	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C322	2610153	Tantalum cap.	10 µ	20 % 6.0x3.2x2.5
C323	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C324	2610153	Tantalum cap.	10 µ	20 % 6.0x3.2x2.5
C325	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C326	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C328	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C329	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C330	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C331	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C334	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C335	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C337	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C338	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C339	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C341	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C400	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C401	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C402	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C403	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C404	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C410	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C411	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C412	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C413	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C414	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C450	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C451	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C452	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C453	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C456	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C457	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C458	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C459	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C460	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206

C462	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C501	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C502	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C503	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C504	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C505	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C506	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C511	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C512	2320550	Ceramic cap.	39 p	5 % 50 V 0402
C513	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C514	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C515	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C516	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C517	2320550	Ceramic cap.	39 p	5 % 50 V 0402
C521	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C536	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C541	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C542	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C543	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C544	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C545	2320728	Ceramic cap.	220 p	10 % 50 V 0402
C546	2320728	Ceramic cap.	220 p	10 % 50 V 0402
C551	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C552	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C553	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C554	2320566	Ceramic cap.	180 p	5 % 50 V 0402
C555	2320566	Ceramic cap.	180 p	5 % 50 V 0402
C556	2320752	Ceramic cap.	2.2 n	10 % 50 V 0402
C557	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C558	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C559	2320752	Ceramic cap.	2.2 n	10 % 50 V 0402
C560	2320752	Ceramic cap.	2.2 n	10 % 50 V 0402
C561	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C562	2320075	Ceramic cap.	470 p	5 % 50 V 0603
C563	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C566	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C569	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C570	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C571	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C572	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C573	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C574	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C575	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C580	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C601	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C602	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C603	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C604	2310784	Ceramic cap.	100 n	10 % 25 V 0805

C605	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C607	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C608	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C609	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C610	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C701	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C702	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C703	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C704	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C705	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C710	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C711	2320558	Ceramic cap.	82 p	5 % 50 V 0402
C712	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C713	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C716	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C720	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C721	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C722	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C723	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C725	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C726	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C728	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C730	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C731	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C732	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C735	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C736	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C737	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C738	2320532	Ceramic cap.	6.8 p	0.25 % 50 V 0402
C739	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C740	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C741	2320556	Ceramic cap.	68 p	5 % 50 V 0402
C742	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C743	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C744	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C755	2320556	Ceramic cap.	68 p	5 % 50 V 0402
C756	2320578	Ceramic cap.	560 p	5 % 50 V 0402
C757	2320578	Ceramic cap.	560 p	5 % 50 V 0402
C758	2320556	Ceramic cap.	68 p	5 % 50 V 0402
C759	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C760	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C761	2320532	Ceramic cap.	6.8 p	0.25 % 50 V 0402
C762	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C764	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C768	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C770	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C780	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C781	2320536	Ceramic cap.	10 p	5 % 50 V 0402

C782	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C783	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C784	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C800	2604079	Tantalum cap.	0.22 µ	20 % 35 V 3.2x1.6x1.6
C801	2310752	Ceramic cap.	10 n	20 % 50 V 0805
C802	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C803	2320568	Ceramic cap.	220 p	5 % 50 V 0402
C804	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C805	2320728	Ceramic cap.	220 p	10 % 50 V 0402
C806	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C807	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C809	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C820	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C821	2313104	Ceramic cap.	1.0 n	2 % 50 V 1206
C822	2320053	Ceramic cap.	56 p	5 % 50 V 0603
C823	2310248	Ceramic cap.	4.7 n	5 % 50 V 1206
C824	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C828	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C829	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C830	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C831	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C832	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C840	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C841	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C842	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C843	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C844	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C845	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C846	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C847	2320602	Ceramic cap.	4.7 p	0.25 % 50 V 0402
C848	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C849	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C850	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C851	2320550	Ceramic cap.	39 p	5 % 50 V 0402
C862	2320602	Ceramic cap.	4.7 p	0.25 % 50 V 0402
C863	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
L151	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L152	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L153	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L200	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L201	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L202	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L203	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L204	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L205	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L206	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L207	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L208	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A

L300	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L301	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L302	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L304	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L307	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L308	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L310	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L311	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L410	3640011	Filter	Z>600Ω/100M	0.6Ω max 0.2 A
L511	3641550	Chip coil	120 n	10 % Q=35 0805
L532	3641550	Chip coil	120 n	10 % Q=35 0805
L541	3641550	Chip coil	120 n	10 % Q=35 0805
L542	3608326	Chip coil	330 n	5 % 1206
L543	3641560	Chip coil	220 n	10 % Q=30/100 MHz 0805
L544	3641560	Chip coil	220 n	10 % Q=30/100 MHz 0805
L545	3608326	Chip coil	330 n	5 % 1206
L546	3608326	Chip coil	330 n	5 % 1206
L551	3641538	Chip coil	39 n	20 % Q=40 0805
L700	3606946	Ferrite bead		0.2Ω 26Ω/100MHz 1206
L705	3640013	Chip coil	8 n	5 % Q=50/250 MHz 0805
L710	3641626	Chip coil	220 n	2 % Q=30/100 MHz 0805
L711	3641542	Chip coil	56 n	10 % Q=40 0805
L800	3641324	Chip coil	10 µ	10 % Q=25/2.52 MHz 1008
L840	3641574	Chip coil	68 n	5 % Q=40 0805
L841	3641538	Chip coil	39 n	20 % Q=40 0805
L842	3641558	Chip coil	8 n	10 % Q=50 0805
B150	4510029	Crystal	32.768 k	20PPM 20PPM
B800	4510075	Crystal	13.000 M	+–5/TSTAB+–7PPM
G001	4352933	Vco	1006–1031 MHz	4.5 V 15 mA
Z500	4512046	SM, dupl.	890–915/935–960 MHz	
Z505	4511016	Saw filter	947.5±12.5 M	RXJP
Z541	4511026	SM, SAW IF filter		71 MHz 10 dBm
Z551	4510009	SM, cer.bpf	13 MHz±90kHz/1 dB	330Ω
Z713	4550101	SM, cer bpf	902.5±12.5MHz	tx
V200	4210100	Transistor	BC848W	npn 30 V SOT323
V201	4210100	Transistor	BC848W	npn 30 V SOT323
V202	4210100	Transistor	BC848W	npn 30 V SOT323
V203	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V250	4864370	Led	Green	1208
V251	4864370	Led	Green	1208
V252	4864378	Led	Green	V 0805
V253	4864378	Led	Green	V 0805
V254	4864378	Led	Green	V 0805
V255	4864378	Led	Green	V 0805
V256	4864370	Led	Green	1208
V257	4864370	Led	Green	1208
V258	4864378	Led	Green	V 0805
V259	4864378	Led	Green	V 0805

V260	4864378	Led	Green	V 0805
V261	4864378	Led	Green	V 0805
V262	4210100	Transistor	BC848W	npn 30 V SOT323
V263	4210100	Transistor	BC848W	npn 30 V SOT323
V264	4210100	Transistor	BC848W	npn 30 V SOT323
V300	4110028	Trans. supr.	16V	23 A 600 W DO214AA
V301	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V302	4210100	Transistor	BC848W	npn 30 V SOT323
V303	4210100	Transistor	BC848W	npn 30 V SOT323
V304	4210092	Transistor		SOT223
V305	4110034	Schottky diode	MBRS140	40 V 1 A DO214AA
V306	4210092	Transistor		SOT223
V307	4219928	TR+RX2	RN2302	p 50V 50mA 10k
V308	4219926	TR+RX2	RN2302	p 50V 50mA 10k
V309	4219926	TR+RX2	RN2302	p 50V 50mA 10k
V310	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V312	4210100	Transistor	BC848W	npn 30 V SOT323
V450	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V501	4210046	Transistor	BFP182	npn 20 V 35 mA SOT143
V502	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V503	4210100	Transistor	BC848W	npn 30 V SOT323
V511	4115802	Sch. diode x 2	4V	30 mA SOT23
V512	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V541	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V701	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V702	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V710	4200755	Transistor	BFR92A	npn 15 V 25 mA SOT23
V725	4200755	Transistor	BFR92A	npn 15 V 25 mA SOT23
V726	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V735	4210100	Transistor	BC848W	npn 30 V SOT323
V736	4217070	Transistor x 2		IMD
V737	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V738	4210090	Transistor	BFG540/X	npn 15 V 129 mA SOT143
V755	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V756	4210133	Transistor	BFG10W/X	npn 10 V 0.25 A SOT343
V765	4210100	Transistor	BC848W	npn 30 V SOT323
V766	4210100	Transistor	BC848W	npn 30 V SOT323
V767	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V768	4210135	Transistor	BLT82	npn 10 V SO8S
V780	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V800	4111092	Cap. diode	BB639	30 V SOD323
V801	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V802	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V840	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V841	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V842	4110018	Cap. diode	BB135	30 V SOD323
D150	4340307	IC, MCU		TQFP80
D151	4370124	Cf70131 gsm/pcn asic bart		SQFP144

D152	4371025	IC, tms320lc541/d36818 gh4 DSP	SQF100
D400	4340305	IC, 512kx8 110ns 3V E28F004BVBT	SO40
D402	4340045	IC, SRAM	TSO28
D404	4343280	IC, EEPROM	2kx8 bit SO8S
D410	4340045	IC, SRAM	TSO28
D411	4340045	IC, SRAM	TSO28
N200	4340013	St5090 audio codec	SO28W
N301	4370199	Stt225b pscld–c pw supply	QFP44
N450	4370207	St7522 rfi2 v2.2 tdma codec	QFP64
N551	4370091	Crfrt_st tx.mod+rxif+pwc	SQFP44
N601	4370095	Crfcontf 8xreg4.5v vref2v5	VSOP28
N820	4340069	IC, 2xsynth 3v UMA1018M/C1/S1	SSO20
X100	5409019	SM, fpc connector	24 poles p 0.8
X101	5460007	20 pole spring type direct board	
X102	5408807	Sim card reader ccm04–5002	3CO2x3con
X103	5469001	System connector	
X501	9510245	Antenna clip	3D25495 NHE–5NX
	9854060	PC board GT8	48.3x150.4x1.0 m6 3/pa

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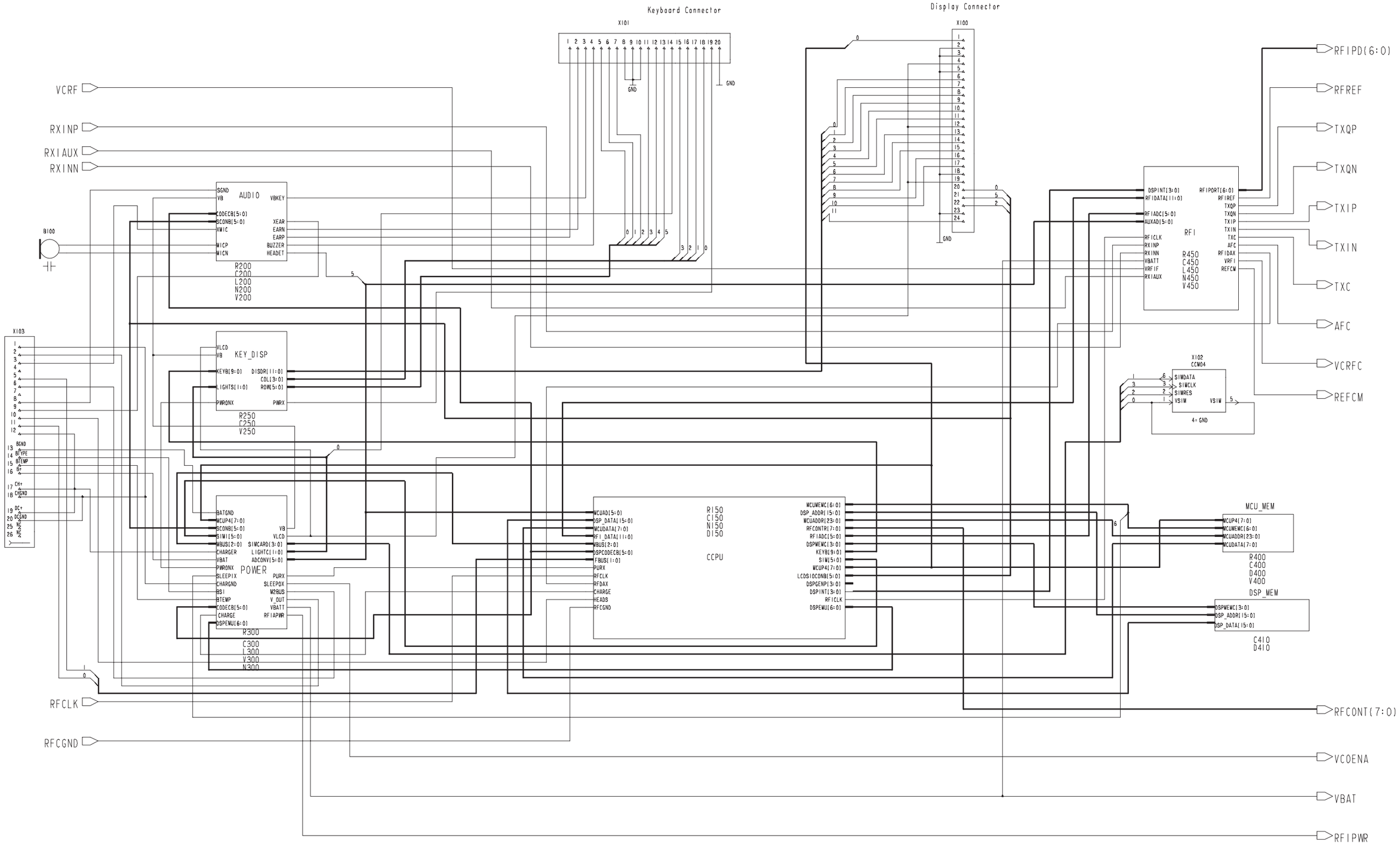
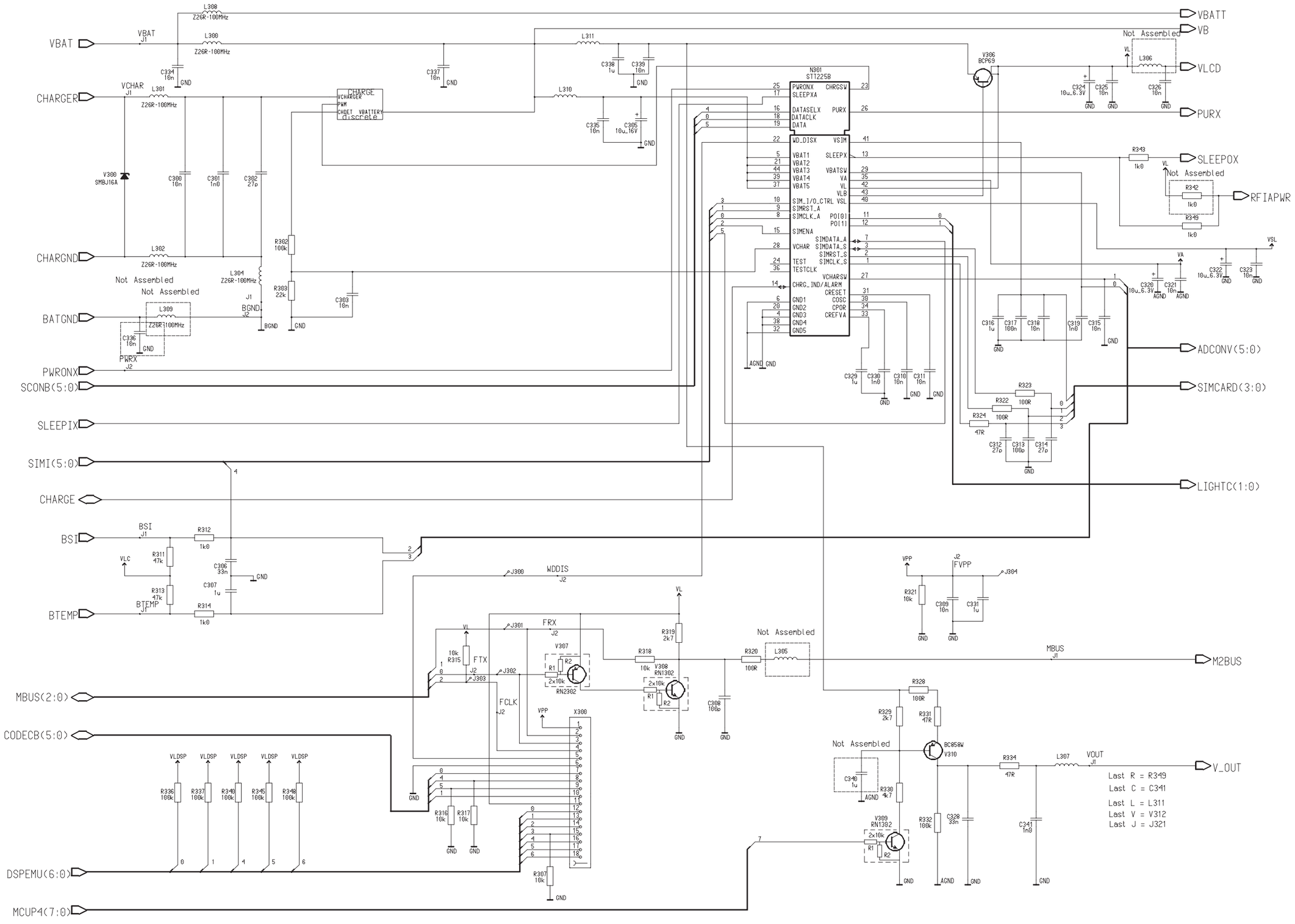
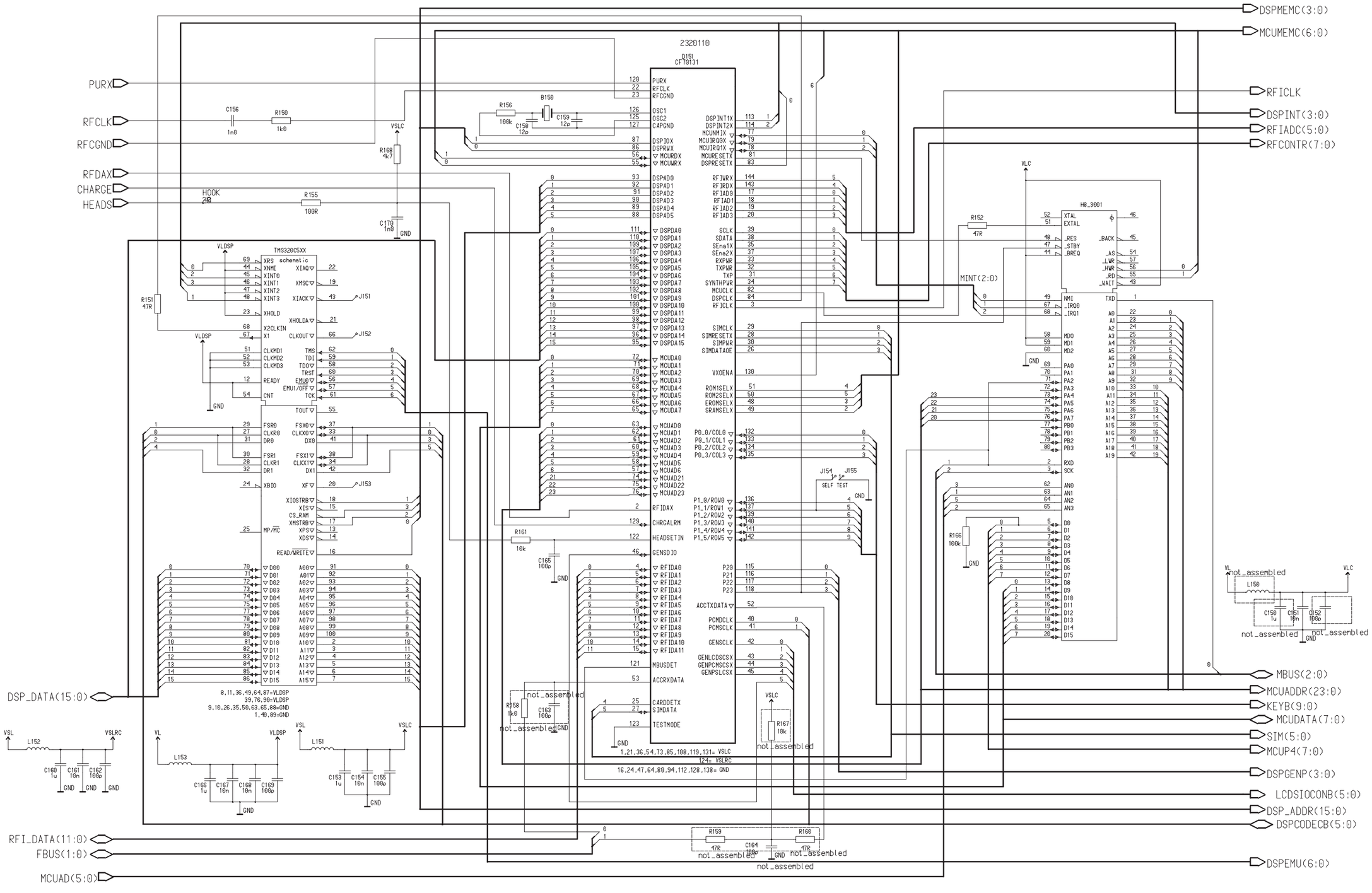
Block Diagram of Baseband (Version: 1.2 V: 3.0 E: 122)



Circuit Diagram of Power Supply & Charging (Version 3.0 ; Edit 178)

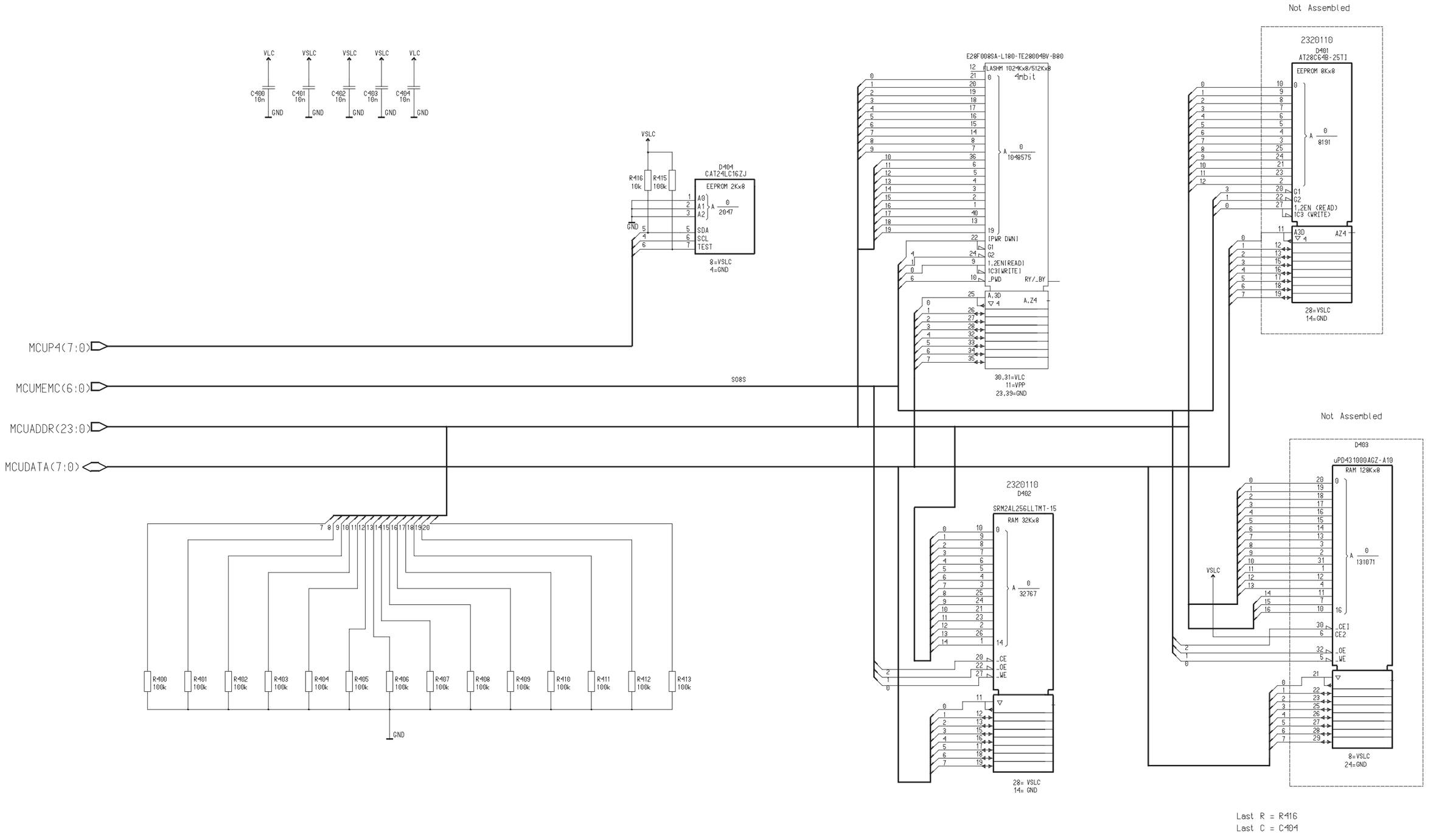


Circuit Diagram of Central Processing Unit (Version: 3.0 ; Edit 151)

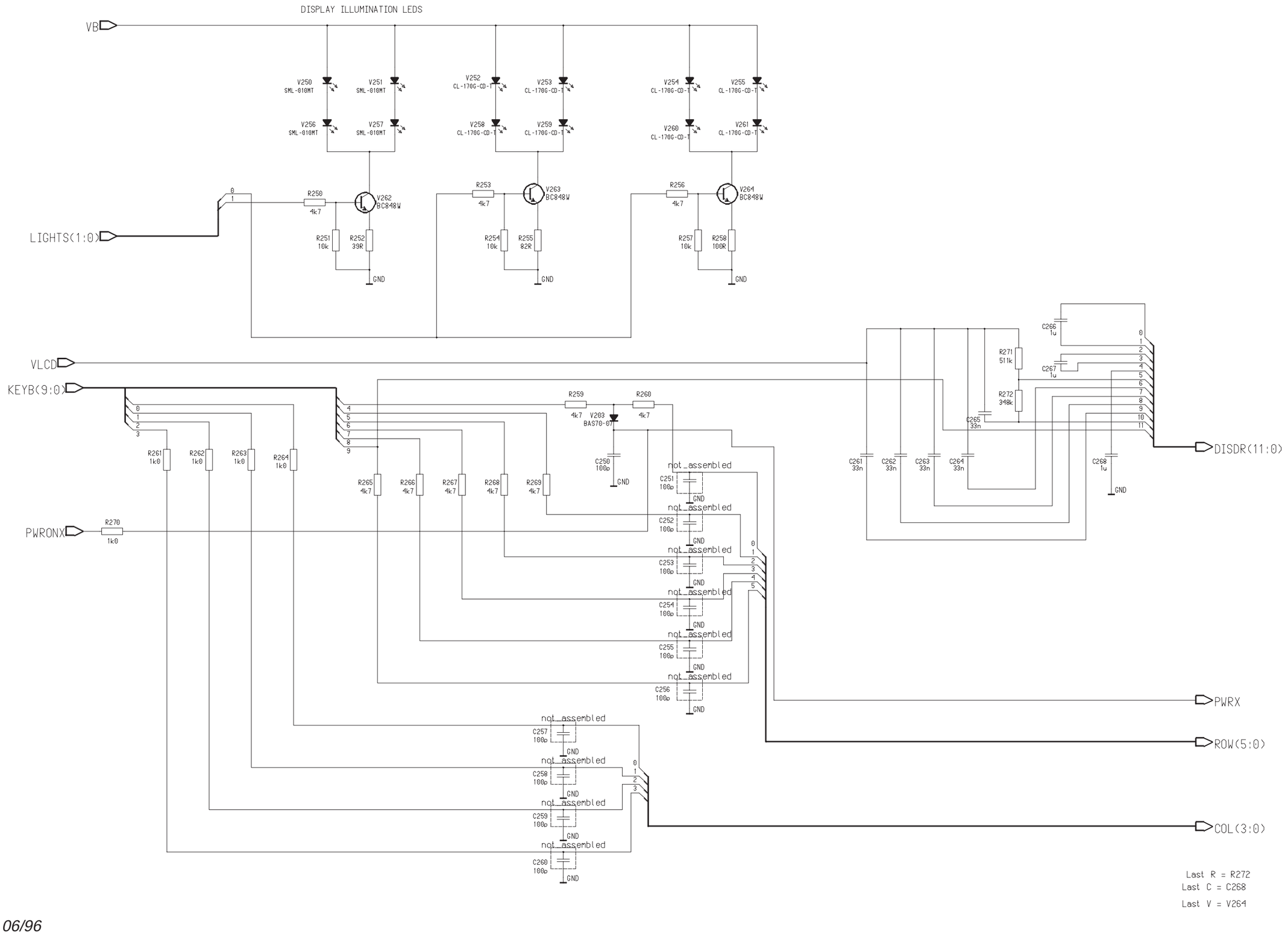


Last L = L153
Last C = C170
Last R = R170
Last D = D152
Last J = J155

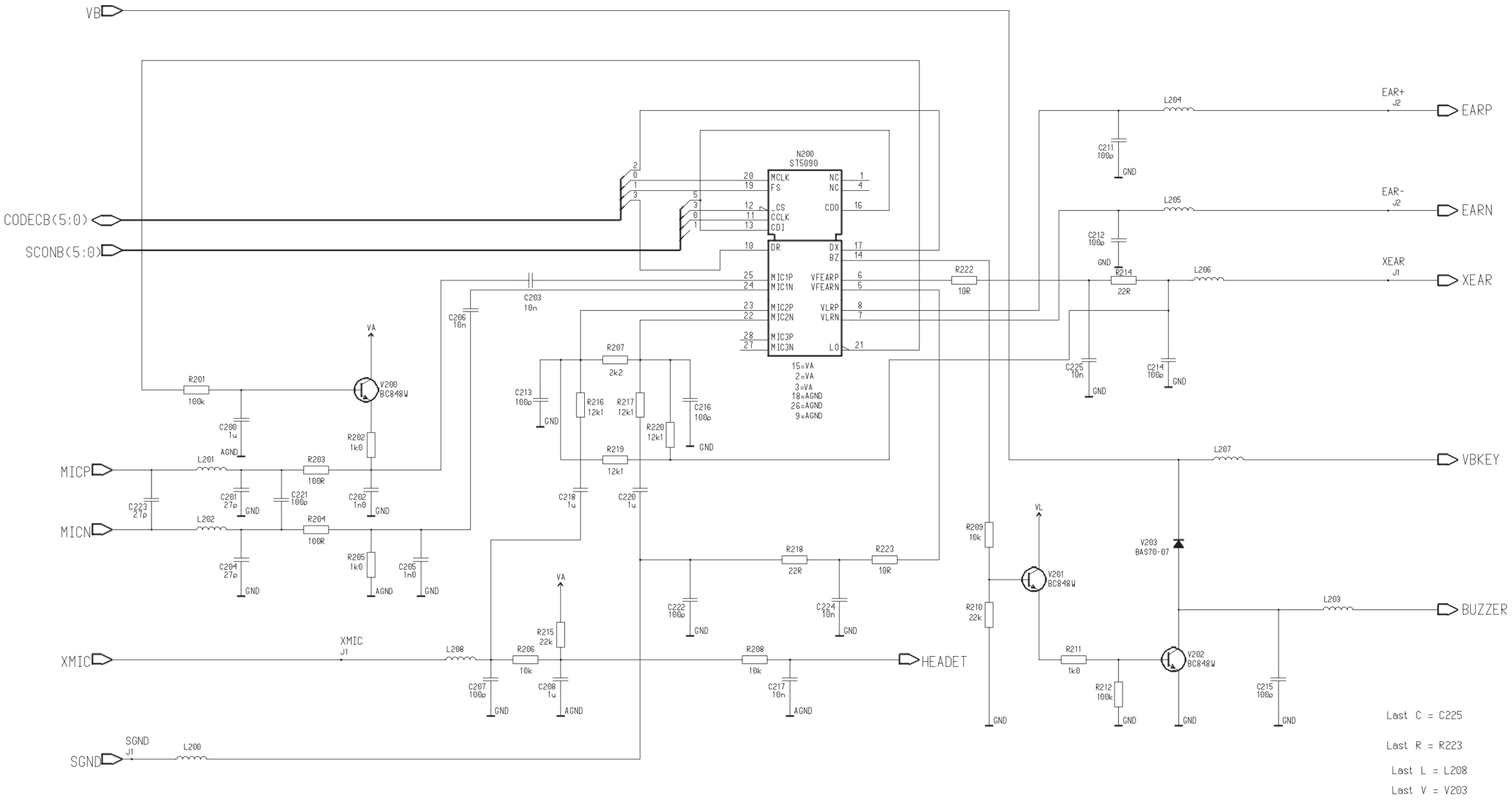
Circuit Diagram of MCU Memory Block (Version: 3.0 ; Edit 87)



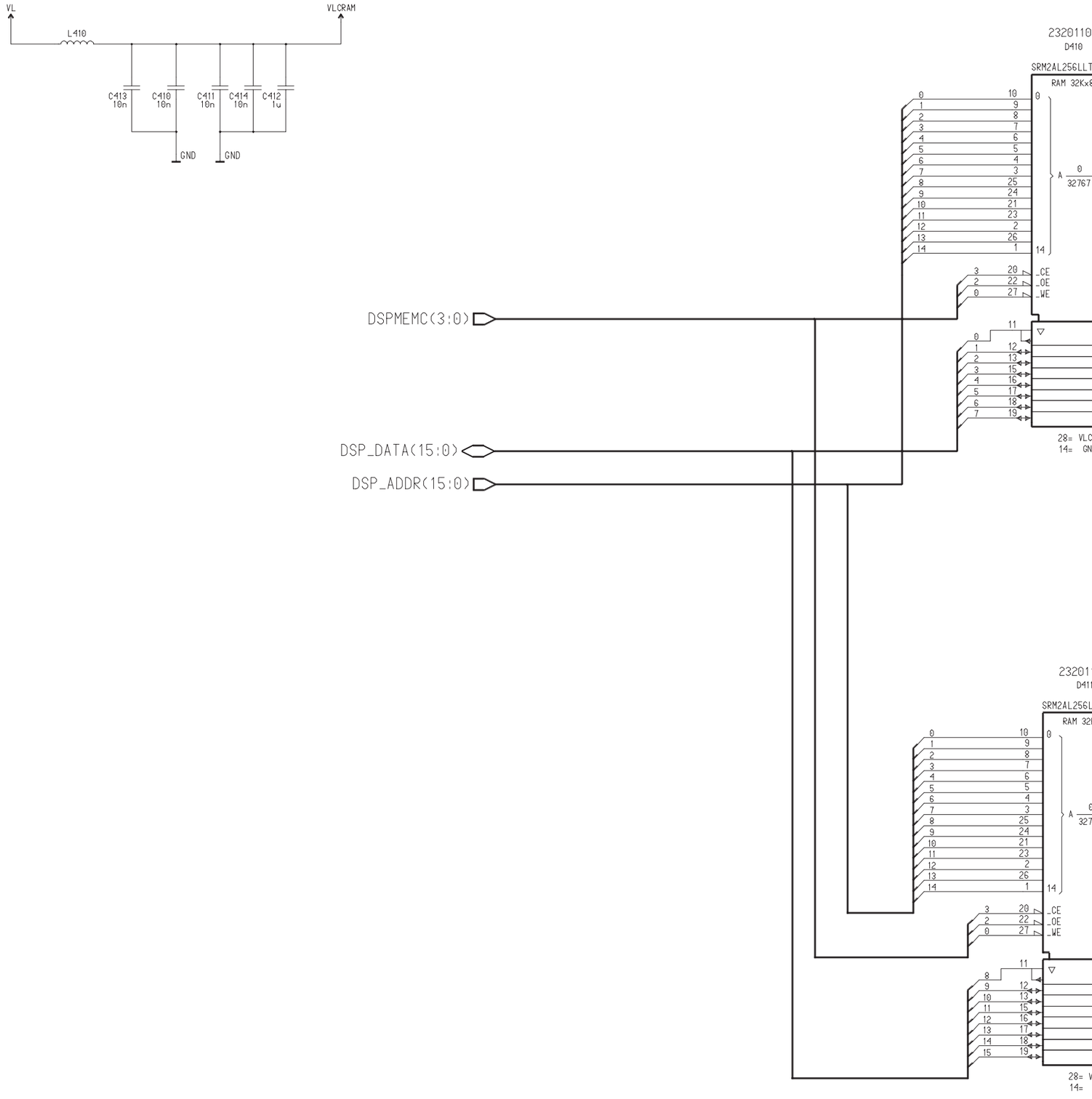
Circuit Diagram of Keyboard & Display Interface (Version: 3.0 ; Edit 72)



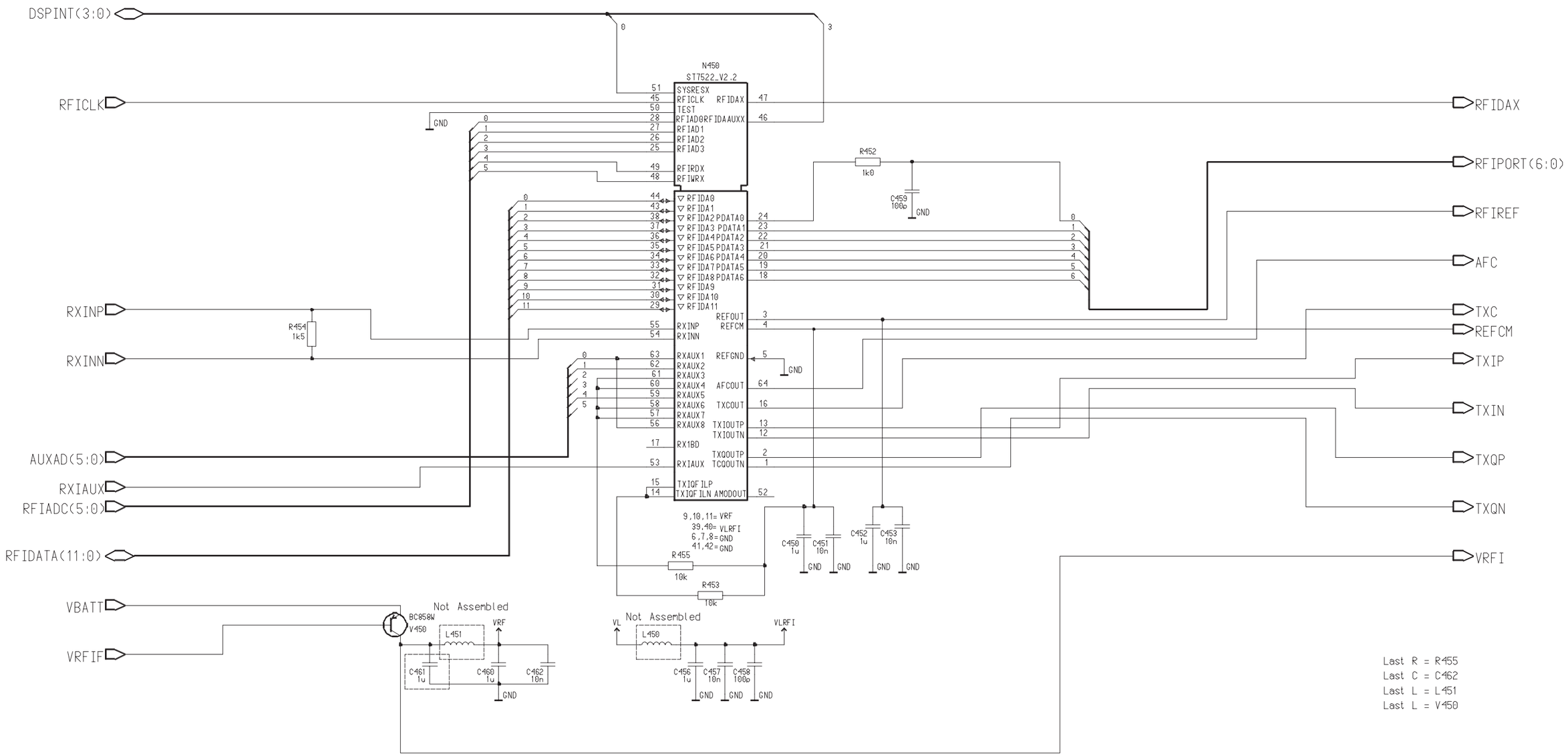
Circuit Diagram of Audio (Version: 3.4 ; Edit 116)



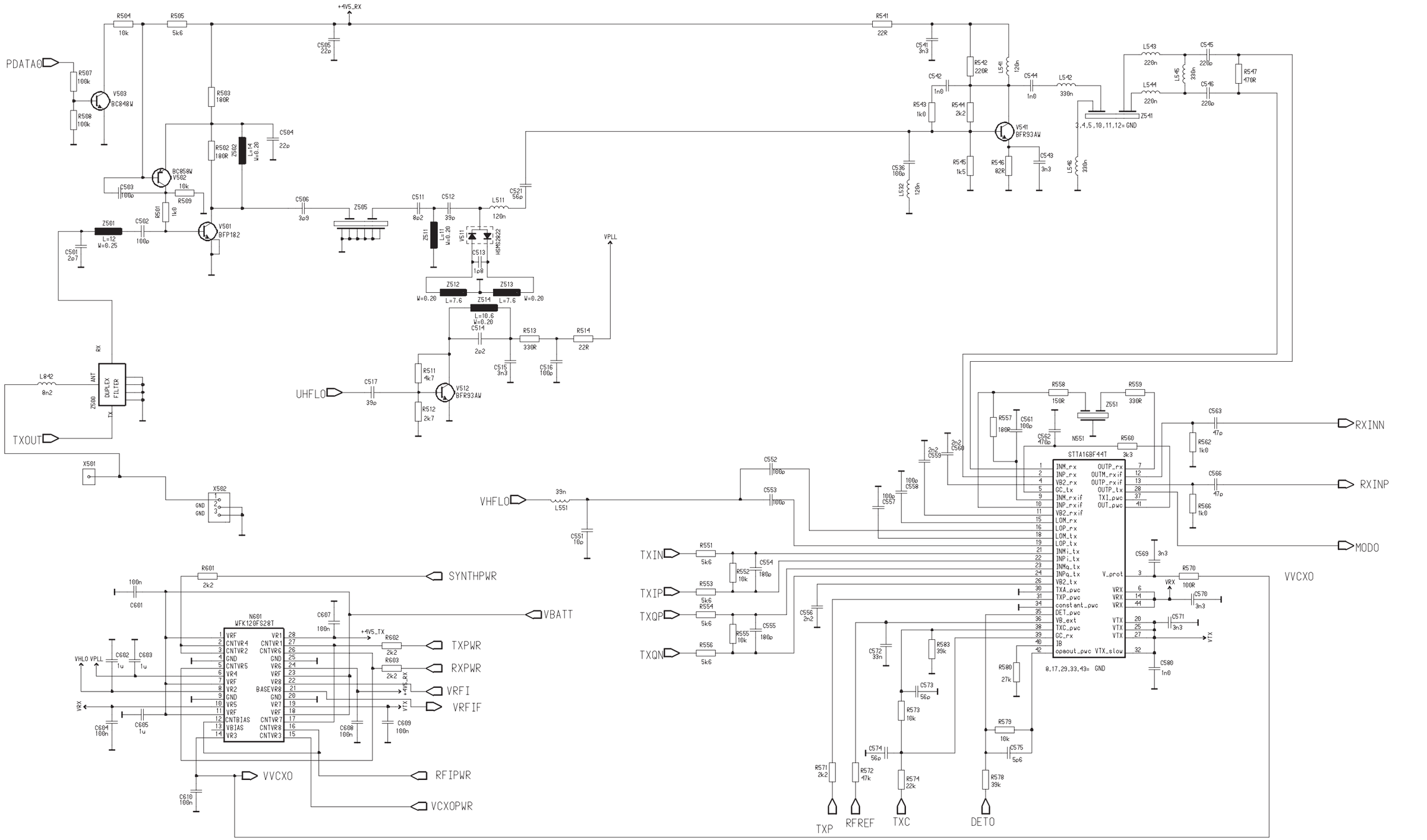
Circuit Diagram of DSP Memory Block (Version: 3.0 ; Edit 53)



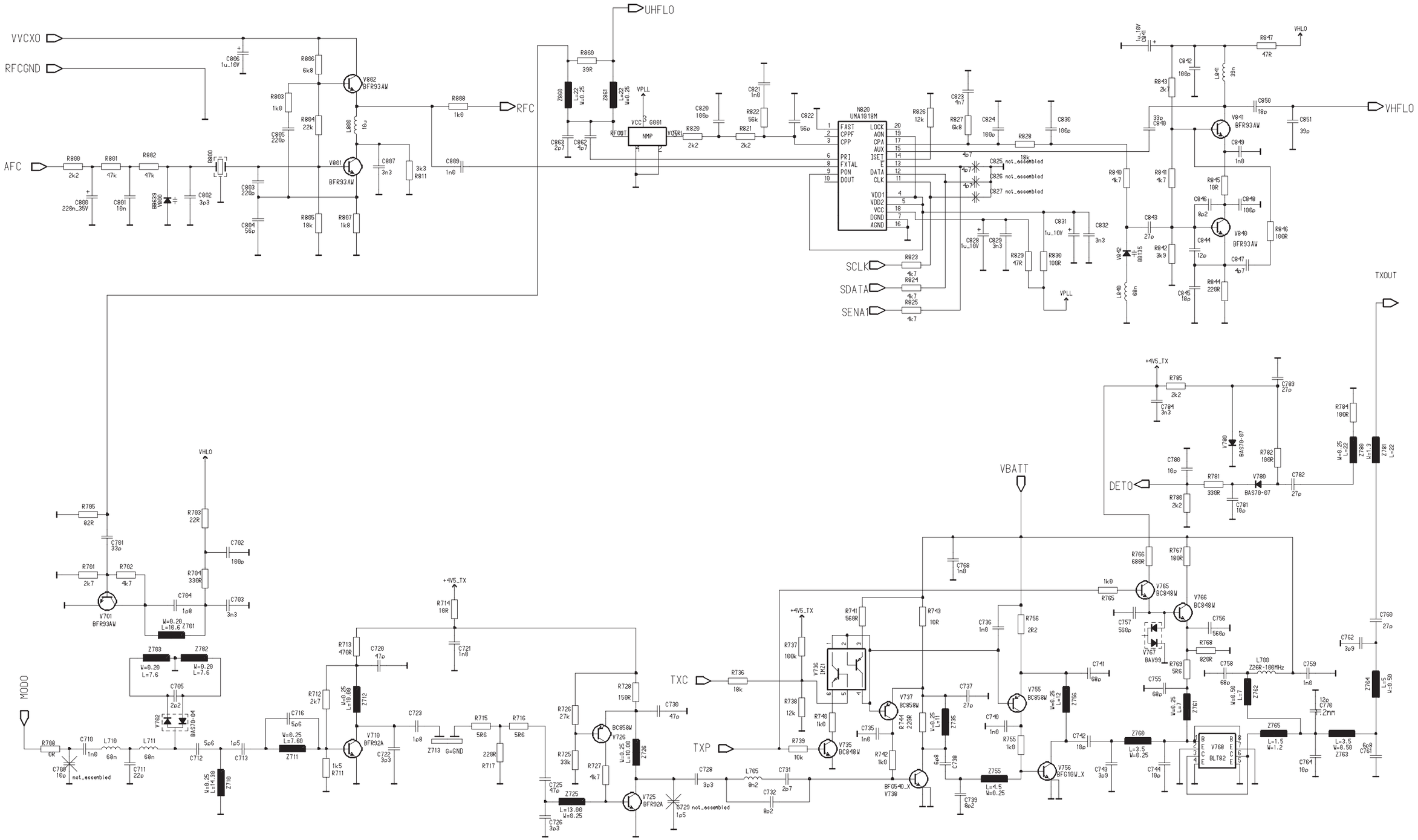
Circuit Diagram of RFI (Version: 3.0 ; Edit 76)



Circuit Diagram of Receiver (Version: 3.8 ; Edit 205)

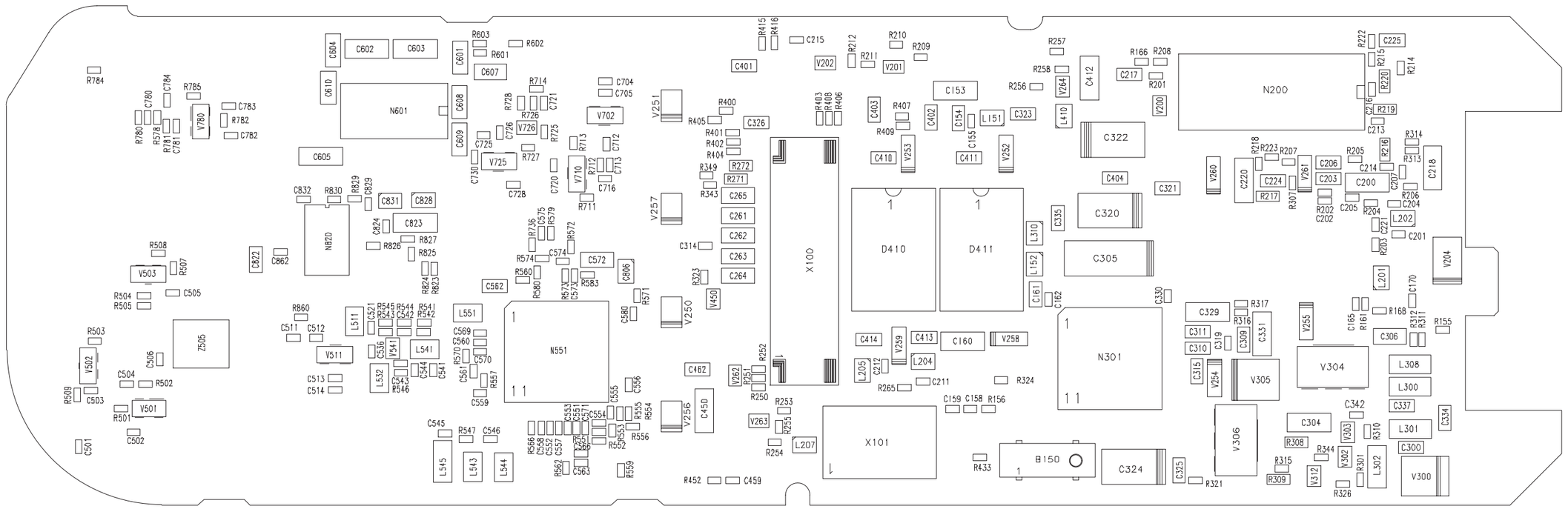


Circuit Diagram of Transceiver (Version: 3.8 ; Edit 235)



Layout Diagrams of GT8 (Version: 18)

Layout Diagrams of GT8 (Version: 20)


N601
N820
N551
X100
D410
D411
N200
C320
C305
C322
N301
V304
V305
V306
B150
C324
X101
V503
V502
V501
Z505
V511
L541
L532
V780
V726
V702
V725
V710
V251
V257
V250
V256
C450
V202
V201
V253
V252
V264
V200
V260
V261
V255
V204
V512
C821
L546
L542
L308
L300
L301
L302
L337
L300
V300
C306
C200
C214
C218
C220
C224
C221
L202
L201
C201
C170
C165
C161
C162
C310
C311
C315
C319
C329
C330
C331
C335
C310
C404
C321
C412
C410
C411
C414
C413
C160
V258
C212
L205
L204
C211
C462
C463
C559
C561
C562
C580
C806
C572
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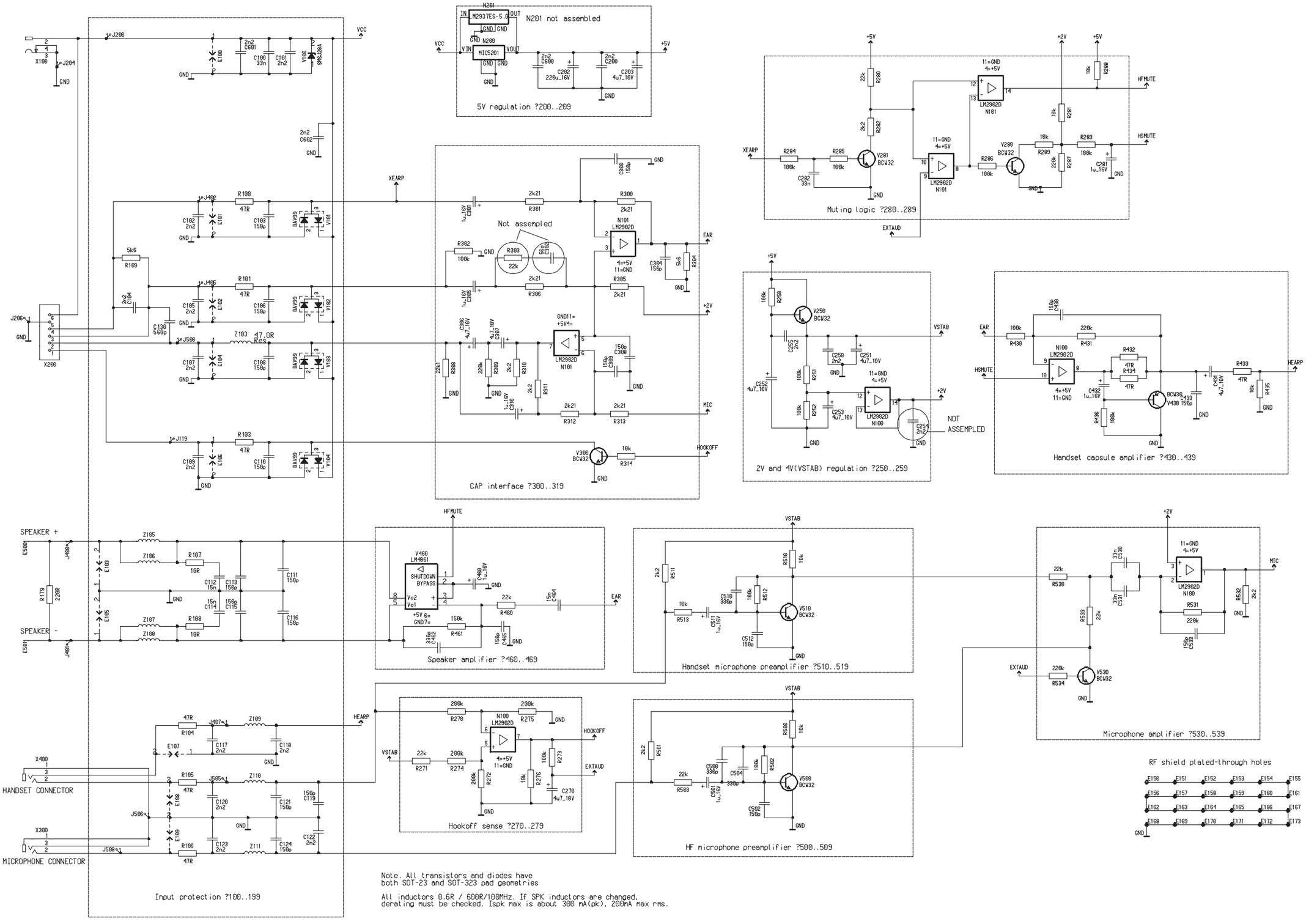
C575
C579
C580
C806
C511
C512
C513
C514
C521
C536
C541
C542
C543
C544

Circuit Diagram of DH6 Section (Version: 12 Edit: 148)


N201 not assembled
5V regulation ?200..209
Not assempled
CAP interface ?300..319
Muting logic ?280..289
2V and 4V(VSTAB) regulation ?250..259
NOT ASSEMPLED
Handset capsule amplifier ?430..439
Input protection ?100..199
Speaker amplifier ?460..469
Handset microphone preamplifier ?510..519
Microphone amplifier ?530..539
Hookoff sense ?270..279
HF microphone preamplifier ?500..509
HANDSET CONNECTOR
MICROPHONE CONNECTOR
SPEAKER +
SPEAKER -
RF shield plated-through holes
Note. All transistors and diodes have
both SOT-23 and SOT-323 pad geometries
All inductors 0.6R / 600R/100MHz. If SPK inductors are changed,
derating must be checked. Ispk max is about 300 mA(pk), 200mA max rms.

After Sales Technical Documentation

NHE–5/NHK–5 INSTALLATION INSTRUCTIONS

Original, 32/96

NMP Part No. 0275073

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

NHE–5 & NHK–5 INSTALLATION INSTRUCTIONS

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Introduction

General

This installation guide has been prepared to provide the basic information necessary to install car kits. This guide is not intended to be definitive, because different types and models of vehicle will require different installation work. The information given is for general guidance only.

The terms of warranty demand that this car kit be installed by an experienced installation facility. An end user should never attempt to install this car kit without professional assistance as the installation requires special tools and knowledge.

Please refer to the telephone's user guide for instructions on the telephone's operation, care and maintenance, including important safety information.

Note: Read the warnings below before beginning the installation procedure.

WARNINGS

1 ENSURE THAT THE VEHICLE BATTERY IS DISCONNECTED BEFORE YOU START THE INSTALLATION PROCEDURE, AND THAT IT REMAINS DISCONNECTED DURING THE PROCEDURE.

2 DO NOT SMOKE OR USE OPEN FLAMES WHEN WORKING NEAR THE VEHICLE'S FUEL SYSTEM.

3 ENSURE THAT ELECTRICAL CABLES, HYDRAULIC LINES AND FUEL LINES ARE NOT DAMAGED DURING INSTALLATION.

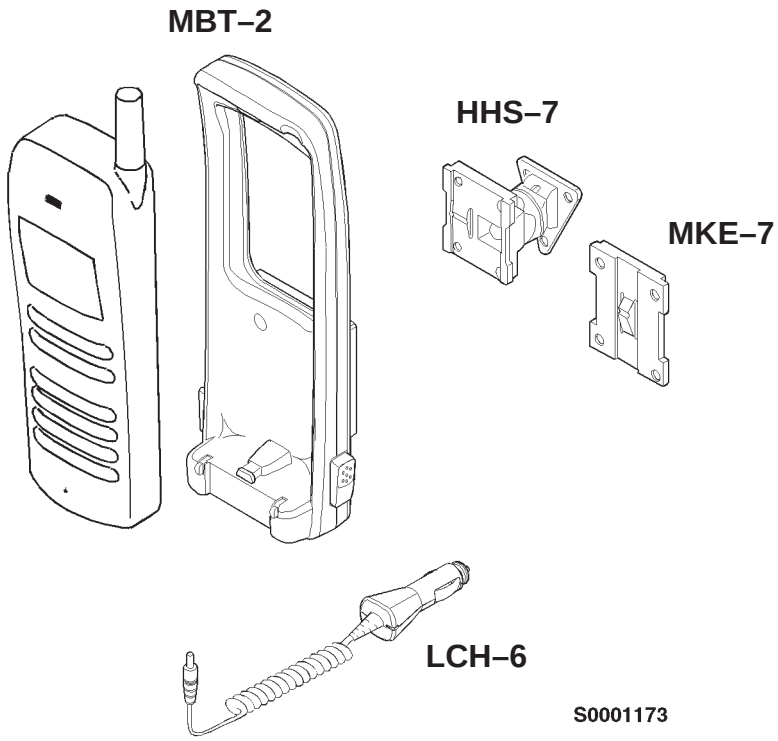
4 ENSURE THAT NORMAL CONTROL AND OPERATION OF THE VEHICLE IS NOT IMPAIRED BY THE INSTALLATION, PARTICULARLY THE BRAKES AND STEERING.

5 ALTHOUGH ELECTRONIC SPEED CONTROL, ABS ANTI–LOCK BRAKE AND FUEL INJECTION SYSTEMS ARE RELATIVELY IMMUNE TO MALFUNCTION CAUSED BY NEARBY RADIO TRANSMISSIONS, SHOULD YOU EXPERIENCE FALSE OPERATION OF THESE SYSTEMS OR ARE IN ANY DOUBT WHATSOEVER AS TO THEIR FUNCTIONALITY, PLEASE CONSULT THE VEHICLE DEALER.

6 THE CAR KIT IS SUITABLE FOR USE ONLY IN VEHICLES WITH A 11..32 V NEGATIVE GROUNDING. USE ON OTHER SUPPLY VOLTAGES OR ALTERNATIVE POLARITY WILL DAMAGE THE EQUIPMENT.

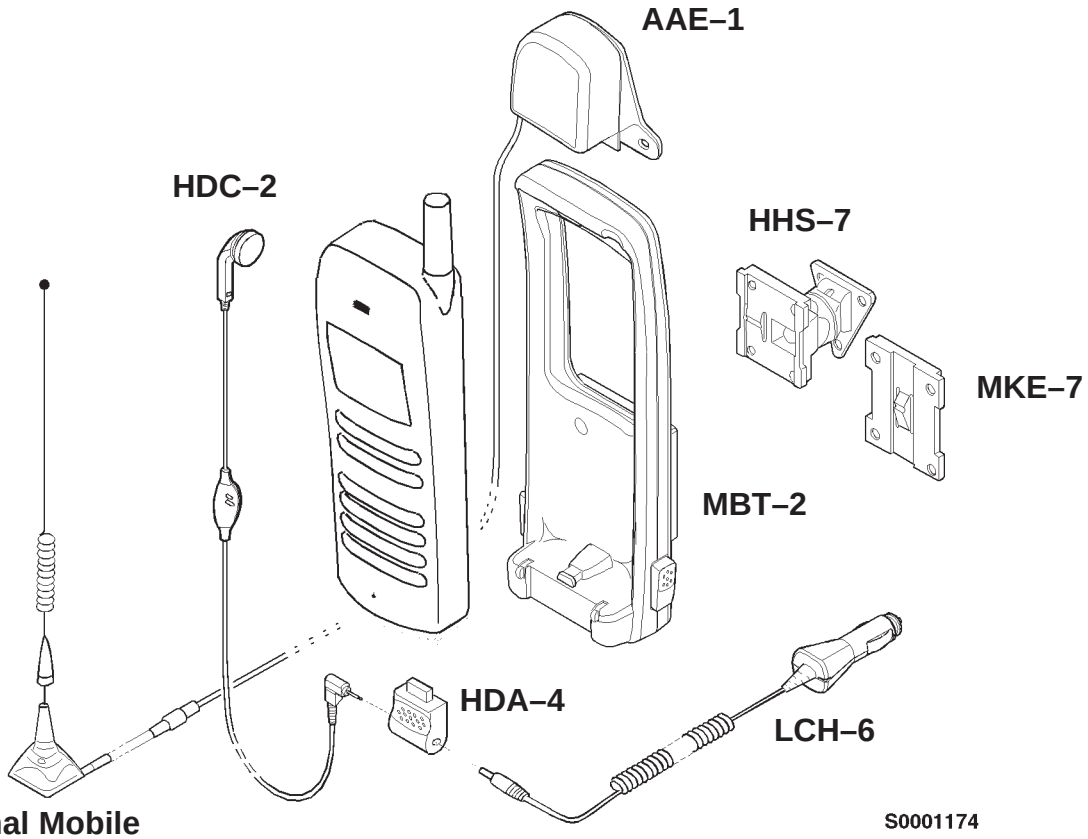
7 THE PHONE SHOULD NOT BE LEFT SWITCHED ON FOR EXTENDED PERIODS WITHOUT RUNNING THE VEHICLE'S ENGINE. FAILURE TO COMPLY COULD DRAIN THE VEHICLE'S BATTERY.

Basic Car Kit



Product Name:	Type:	Code:
Phone Holder	MBT–2	0620028
Mounting Plate	MKE–7	0650007
Swivel Mounting Plate	HHS–7	
Universal Mobile Charger	LCH–6	0675076

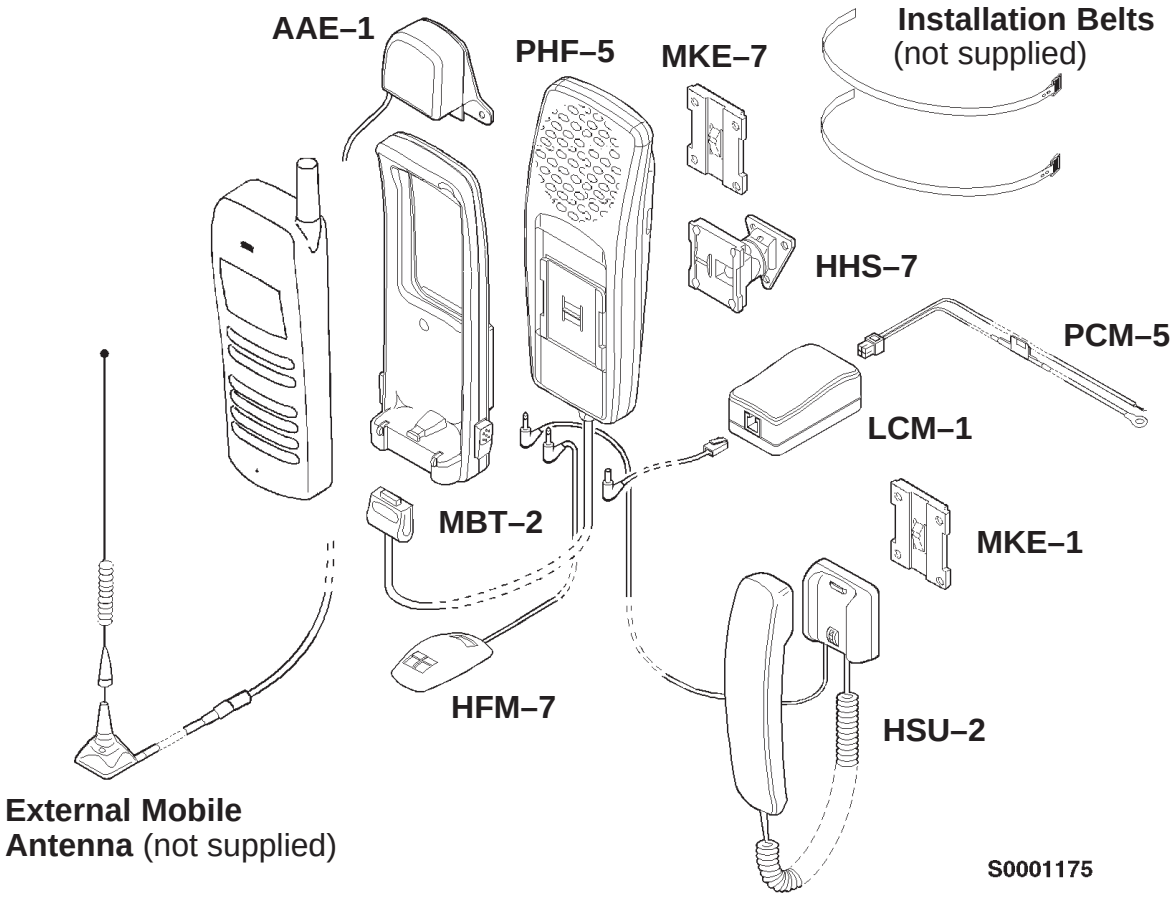
Extended Car Kit



External Mobile Antenna (not supplied)

Product Name:	Type:	Code:
Phone Holder	MBT–2	0620028
Mounting Plate	MKE–7	0650007
Swivel Mounting Plate	HHS–7	
Universal Mobile Charger	LCH–6	0675076
External Antenna Module	AAE–1	0750080
Headset Adapter	HDA–4	069...
Headset	HDC–2	0694017

Complete Car Kit



Product Name:	Type:	Code:
Phone Holder	MBT–2	0620028
Basic Handsfree Unit	PHF–5	0694028
Mounting Plate	MKE–7	0650021
Mounting Plate (for HSU–2)	MKE–1	0650007
Swivel Mounting Plate	HHS–7	
Fixed Mobile Charger	LCM–1	0675077
Power Cable	PCM–5	0730058
External Antenna Adapter	AAE–1	0750080
Handsfree Microphone	HFM–7	0690002
Handset	HSU–2	0640078
Universal Mobile Charger (optional)	LCH–6	0675076
Headset (optional)	HDC–2	0694017

Component Parts

Phone Holder MBT–2

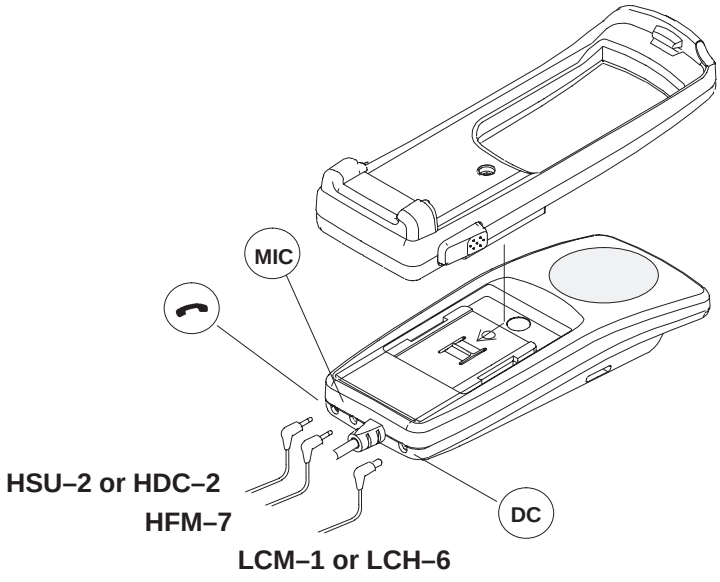
The phone holder allows the phone to be firmly located in a convenient position. The phone holder is attached to the vehicle interior using mounting plate MKE–7 or alternatively swivel mounting plate HHS–7.

Basic Handsfree Unit PHF–5

The basic handsfree unit enables the phone to operate in handsfree mode. The unit is attached to the vehicle interior using mounting plate MKE–7, or swivel mounting plate HHS–7. A temporary installation can be achieved using the installation belts.

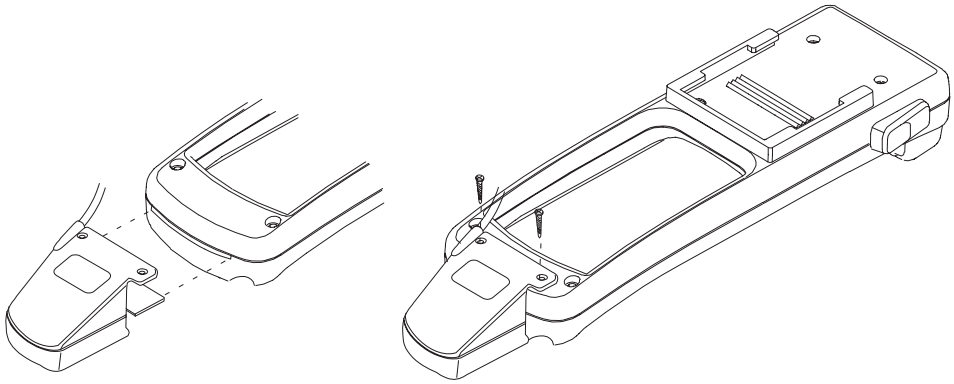
Power is supplied either from the vehicle battery via the fixed mobile charger or from the cigarette lighter socket via the universal mobile charger. The basic handsfree unit provides the power supply to the phone via the system connector.

The handset, HSU–2, or the headset, HDC–2, connect to the ✆ socket. The HF microphone, HFM–7, connects to the **MIC** socket. The phone holder can be attached to the basic handsfree unit as shown.



External Antenna Adapter AAE–1

The external antenna adapter allows an external antenna to be capacitively coupled to the phone's antenna when the phone is located in the phone holder. The external antenna adapter is fastened to the top of the holder as shown below.



Mounting Plate MKE–7 and Swivel Mounting Plate HHS–7

MKE–7 is a fixed position mounting plate; HHS–7 is swivel mounting plate which allow for adjustable fixing. Both mounting plates are interchangeable.

Fixed Mobile Charger LCM–1

The fixed mobile charger provides a power supply for the basic handsfree unit.

Output Power Cable PCC–1

The output power cable connects the fixed mobile charger to the basic handsfree unit.

Power Cable PCM–5

The power cable connects the fixed charger to the vehicle supply. The red wire must be connected to the +ve supply controlled by the vehicle's ignition key via the supplied fused connector. The black wire must be attached to a good negative GND connection.

Handsfree Microphone HFM–7

The handsfree microphone connects directly to the basic handsfree unit.

Handset HSU–2

The handset is installed using a mounting plate MKE–1 as supplied. The handset connects directly to the basic handsfree unit.

Headset HDC–2

A headset offers privacy during a call. The headset connects to the headset adaptor's socket or the ↶ socket located at the base of the basic handsfree unit.

Headset Adapter HDA–4

The headset adapter provides connections between the headset, power supply and the phone. The adapter plugs into the base of the phone.

The headset adapter provides the power supply for the phone which must be connected to the headset adapter; power is supplied via the universal mobile charger.

Universal Mobile Charger LCH–6

The universal mobile charger enables the phone to be charged via the vehicle's cigarette lighter socket. The charger connects to the headset adapter via a d.c. jack socket located on the side of the adaptor or the basic handsfree unit via a d.c. jack socket located on the base of the unit marked DC. The supply voltage may vary between 11 and 32 V.

External Mobile Antenna (not supplied)

The external antenna adapter is designed to operate with a high quality external antenna. However, due to many different types of antennas being available, an antenna is NOT included as part of car kits. Please, consult the dealer to find out which is the most suitable antenna type for your installation.

Installation

There are some important aspects that require special attention in positioning car kit accessories.

The positioning of the phone holder is the most important factor when trying to achieve the most comfortable position for the user. The location of the holder should be selected so that the visibility of the phone's display is good under all lighting conditions, but not so that the driver's attention is easily distracted. The holder should be located so that the driver can easily reach the keypad. Under no circumstances should the holder prevent the driver from controlling or operating the vehicle in any way or observing traffic.

The handset should be located within easy reach of the user, ensuring that the driver is not prevented from controlling or operating the vehicle in any way or observing traffic.

The fixed mobile charger can be installed in a hidden location, since there is no need to disconnect cables during normal operation. Ensure the location does not subject the unit and cables to moisture or mechanical pressure. Also remember clean the mounting tape location properly before installing.

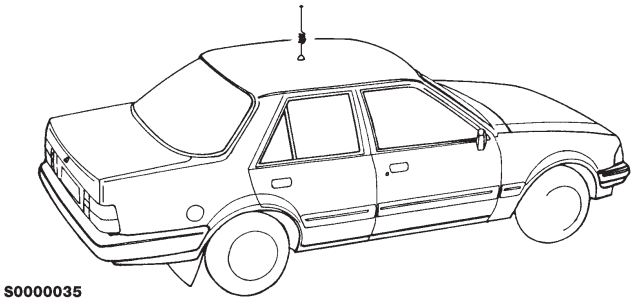
The handsfree microphone can be installed on the driver's sun visor or the A–pillar. Ensure the microphone is as close to the driver's mouth as possible, and attached to a surface that is mechanically quiet. The microphone should be mounted at least 3 ft/1 m away from the handsfree unit speaker to avoid acoustic feedback. See separate microphone installation guide.

Ensure cables are routed as far away as possible from the vehicle's electronic systems (refer to WARNINGS). Also ensure cables are not subjected to undue mechanical stress e.g. under seats or against sharp edges. The external antenna adapter should always be connected to the antenna via a non–radiating cable (e.g. coax).

The most important component of the installation is the antenna. The location of the antenna as well the quality of the antenna and its installation have a considerable influence to the overall performance of the whole system. Therefore it is necessary to emphasize some aspects, which too often have caused unnecessary service work.

The best place for the antenna is the rooftop. The overall performance of a rooftop antenna is clearly superior to any other antenna type or location. The Antenna should be mounted in a position such that no part of a human body will normally rest too close to any part of the antenna unless there is a an intervening metallic screen, for example, the metallic roof.

- highest place in the car
- proper ground place
- omnidirectional radiation pattern
- minimum risk for disturbances
- user safety



After drilling the hole for the antenna remember to clean the hole from the drilling swarf, so that surface is even. This is needed in order to ensure proper and reliable connection between the ground plane and the antenna. After cleaning it is advised to apply some rust–proofing compound to the hole.

Mount the base of the antenna tightly to its place. Consult the antennas manuals for determining the maximum bending angle before attempting any bending operation.

To avoid drilling a hole in the vehicle's bodywork, a glass–mounted antenna can be chosen and located on the rear window of the vehicle.

Try to route the antenna cable so that possible sources of disturbances are avoided, as well anti–skid brake systems. The shorter the antenna cable, the smaller the attenuation, and the better the performance of the antenna. The antenna coupler should always be connected to the antenna via a non–radiating cable (e.g. coax).

Most of the antennas today have adapted the mini–crimp connector system which eliminates the need for special crimping tools and connectors. If however the purchased antenna has traditional connectors, use only proper connectors and tools. The antenna coupler uses TNC–female type antenna connector for reasons of reliability and attenuation.

All installations should take into account any special requirements of the customer. However, should the customer require an installation that is illegal or unsafe these facts must be pointed out to the customer and a policy of non–compliance adopted.

Testing

Once installed, the equipment should be tested to ensure that it is operating satisfactorily and that the position of the units does not impair on the driver's ability to control and operate the vehicle in any way.

Use the phone to make a call when the vehicle is parked with the engine running. During the call, switch off the engine. Ensure that the phone is operational with the engine running and with the engine switched off. For operating information refer to the 'User's Guide' supplied with the phone.

After Sales Technical Documentation

NHE–5/NHK–5 NON–SERVICEABLE ACCESSORIES

Original 32/96

NMP Part No. 0275072

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

NHE–5/NHK–5 NON–SERVICEABLE ACCESSORIES

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List of Non–Serviceable Accessories

Battery Pack BBT–7S and BBT–3S

The BBT–7S NiCd light battery and BBT–3S NiMH slim battery pack provide an acceptable level of performance in a package (ie including phone) weighing 251 g.

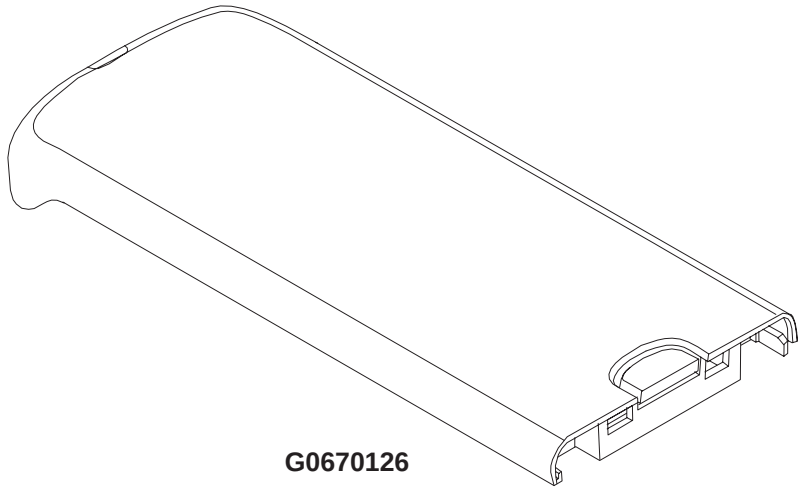
Product Code

Battery pack BBT–7S:	*0670126*
Battery pack BBT–3S:	*0670125*

Specification

Dimensions (h x w x d):	*58 x 132 x 9 mm*
Weight:	*113 g*
Capacity	
• BBT–7S:	*450 mAh*
• BBT–3S:	*600 mAh*

View of Battery Pack



G0670126

Battery Pack BBT–2S and BBT–2H

The BBT–2S NiCd extended battery pack and BBT–2H NiMH ultra extended battery pack provide the best compromise between weight and performance for the average user. A extended package (ie including phone) weights 283 g and an ultra extended package 303 g.

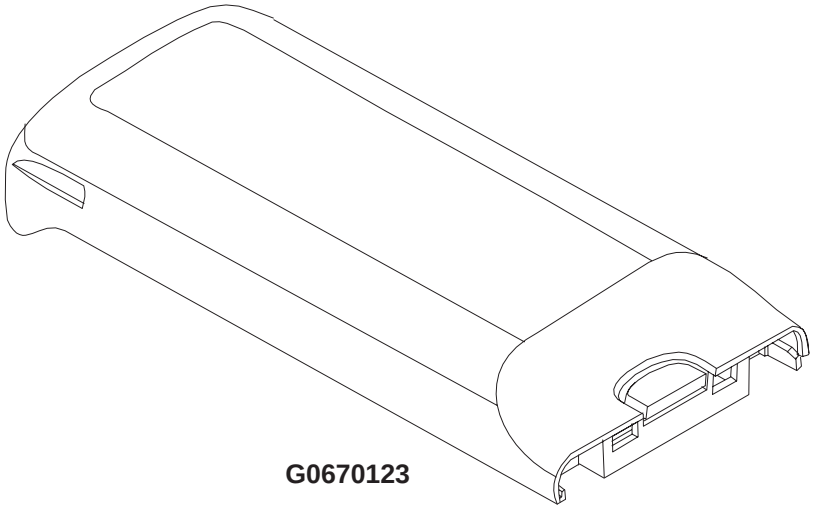
Product Codes

Battery pack BBT–2S:	*0670123*
Battery pack BBT–2H:	*0670124*

Specification

Dimensions (h x w x d):	*58 x 132 x 17 mm*
Weight	
• BBT–2S:	*145 g*
• BBT–2H:	*165 g*
Capacity	
• BBT–2S:	*950 mAh*
• BBT–2H:	*1200 mAh*

View of Battery Pack



G0670123

Standard Charger ACH–8

Use this durable and economical charger to charge all battery options – simply plug the charger into a wall outlet and connect the connector to the bottom of your phone. Check the charging status on the phone display.

The charging time is about 2 h 30 for the 470 mAh battery.

You can make calls while charging. However, charging is suspended for the duration of the call.

Standard charger is available for different voltage levels and comes with different wall plugs.

Standard charger can also be used as a power supply for the basic stand and desktop stand.

Product Codes

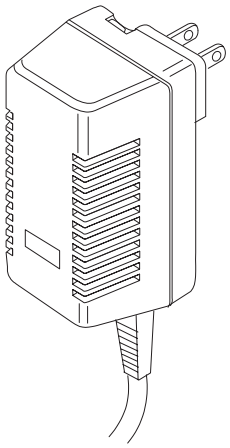
Standard charger ACH–8U (USA plug):	*0675091*
Standard charger ACH–8E (Euro plug):	*0675089*
Standard charger ACH–8X (UK plug):	*0675090*

Specification

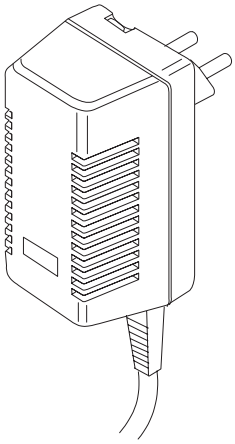
Dimensions (h x w x d):	*86 x 50 x 44 mm (without plug)*
Weight:	*< 300 g*
Cable length:	*1950 mm*
Mains plug type:	*see picture*
Output connectors:	*3.0 mm standard d.c. plug*
Protection:	*output current limiting, max. 300 mA* *output voltage limiting, max. 16 V (unloaded)*
Input voltage:	*180 to 250 V (110 V ACH–8U)*

View of Standard Chargers

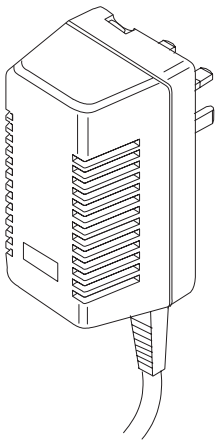
ACH–8U



ACH–8E



ACH–8X



S0001160

Fast & Light Charger ACH–6

Extremely light, functionally designed fast & light charger charges your phone battery quickly.

Plug the charger into a wall outlet and connect the connector to the bottom of your phone. When not using the charger, you can wrap the cord around it and attach the loose end to the slot on top.

The charging time is approximately 45 minutes for the 470 mAh battery. Check the charging status on the phone display. You can use your phone also while charging.

Operating within voltage range 90 V...250 V AC (50 Hz...60 Hz), fast & light charger is practically current independent in normal office and household use. Like standard charger, fast & light charger is compatible with all battery options and is available with different wall plugs.

The fast & light charger can also be used with basic stand and desktop stand.

Product Codes

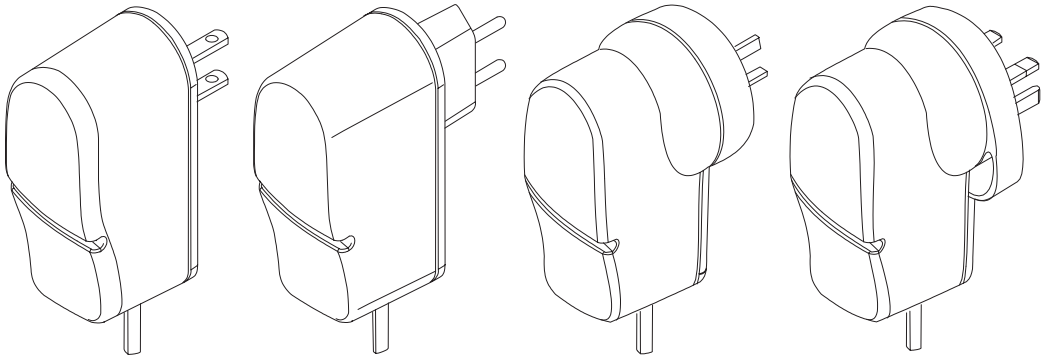
Fast & light charger ACH–6U (USA plug):	*0675085*
Fast & light charger ACH–6E (Euro plug):	*0675084*
Fast & light charger ACH–6A (Austr. plug):	*0675086*
Fast & light charger ACH–6X (UK plug):	*0675087*
Output cable PCC–1 (supplied with ACH–6):	*0730076*

Specification

Dimensions (h x w x d):	*75 x 29 x 42 mm (without plug)*
Weight:	*< 150 g*
Output cable length:	*1950 mm*
Mains plug type:	*see picture*
Output connectors:	*3.0 mm standard d.c. plug*
Protection:	*output current limiting, max. 870 mA output voltage limiting, max. 11 V (unloaded)*
Input voltage:	*90 to 250 V*

View of Fast & Light Chargers

ACH–6U ACH–6E ACH–6A ACH–6X



S0001161

Basic Stand CGH–2

This charging stand is an economical choice for users who wish to have their phone close at hand, always ready for calls.

Charging times for the 470 mAh battery are approximately 2 h 30 or 45 min, depending on the charger used. The basic stand is used together with the standard charger or fast & light charger.

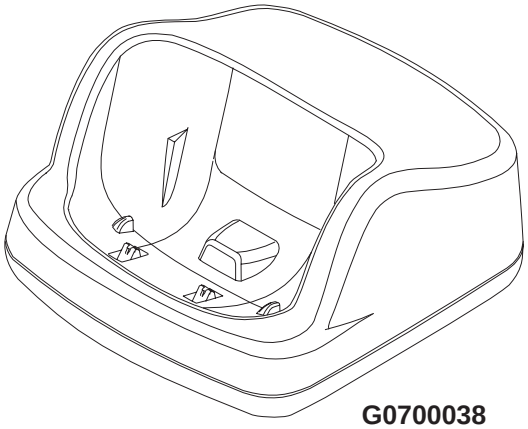
Product Code

Basic stand CGH–2:	*0700038*

Specification

Dimensions (h x w x d):	*42 x 75 x 80 mm*
Weight:	*40*
Connections:	*3.0 mm d.c. jack*
Charge control:	*none*
Maximum input voltage:	*16 V*
Maximum input current:	*820 mA/10.8 V*
Protection:	*no damage if short circuit in output*

View of Basic Stand



G0700038

Desktop Stand CGH–1

The desktop stand provides mounting place for both the phone and a spare battery.

Charging order is the phone battery first, and then the spare battery. Check the charging status of the phone battery on the phone display.

Compatible with all battery options, the desktop stand is used together with the standard charger or fast & light charger. Charging times for the 470 mAh battery are approximately 45 min or 2 h 30, respectively.

In addition, the desktop stand offers a discharging facility for the spare battery. Discharging helps extend battery life. Place the spare battery in the stand and press the discharge button. When the battery is totally discharged, recharging will begin automatically. You can also stop discharging before it is finished by pressing the button again. Recharging will begin immediately.

The discharge button is equipped with LED indication for the spare battery. A blinking red light indicates discharging. A continuous red light indicates recharging, and a green light indicates the spare battery is full. Charge until the light turns green.

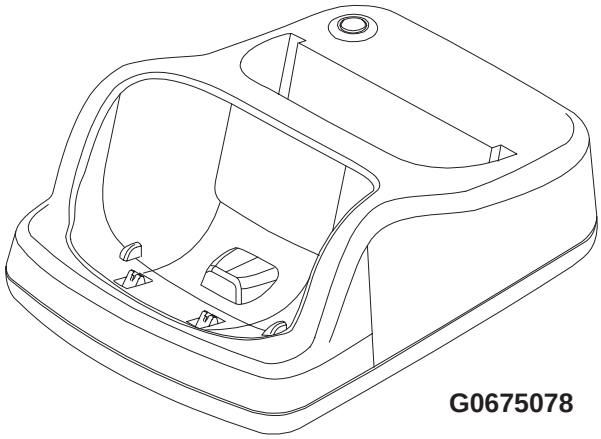
Product Code

Desktop stand CGH–1:	*0675078*

Specification

Dimensions (h x w x d):	*43 x 75 x 100 mm*
Weight:	*70 g*
Connections:	*3.0 mm d.c. jack*
Charge control:	*cell voltage (peak or negative change), time control, cell temperature*
Operation input voltage:	*9...16 V*
Max. input current:	*780 ±40 mA*
Discharge current:	*308...360 mA*
Discharge end voltage:	*4 V ±7 %*
Protection:	*no damage if short circuit in output*

View of Desktop Stand



G0675078

Phone Holder MBT–2

Designed to fit and complement your car's interiors, phone holder holds your phone firmly in place by its three–point hold and stiff structure.

The phone holder is attached to the vehicle's interior using mounting plate, MKE–7 or alternatively swivel mounting plates, HHS–6 or HHS–7.

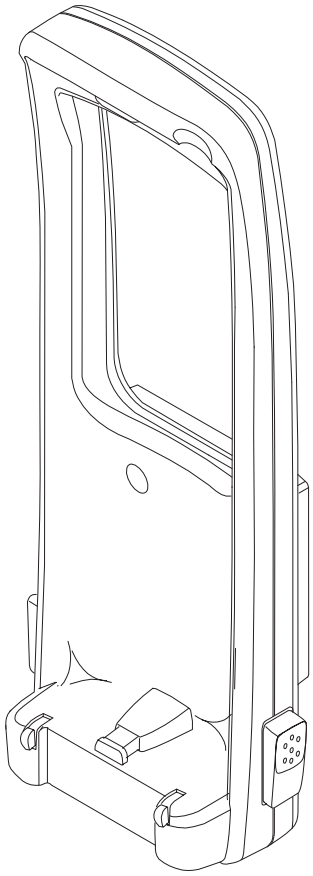
Product Code

Phone holder MBT–2:	*0620028*

Specification

Dimensions (h x w x d):	*186.5 x 59.5 x 40 mm*
Weight:	*g*

View of Phone Holder



G0620028

Mounting Plate MKE–7

The MKE–7 mounting plate provides a method of fixing the phone holder, the compact handsfree unit or the handset to the vehicle interior.

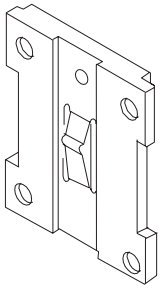
Product Code

Mounting plate MKE–7:	*0650021*

Specification

Dimensions (h x w x d):	*7.3 x 45 x 48 mm*
Weight:	*8 g*

View of Mounting Plate



G0650021

Swivel Mounting Plate HHS–7

The HHS–7 swivel mounting plate provides an alternative (to MKE–7) method of locating the phone holder, the basic handsfree unit or the handset.

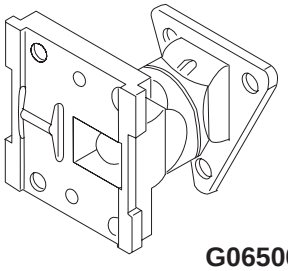
Product Code

Swivel mounting plate HHS–7:	*0650020*

Specification

Dimensions (h x w x d):	*20 x 44 x 48 mm*
Weight:	*30 g*

View of Swivel Mounting Plate



G0650020

Universal Mobile Charger LCH–6

The universal mobile charger ensures your phone is always ready for use wherever you travel. This small charger's functional design fits well to most car lighters and interiors.

The charging time for the 470 mAh battery is about 45 minutes, and you can use your phone freely during charging.

A green light indicates that the cigarette lighter charger is ready for charging. Check the charging status on the phone display. The input voltage can be 12 or 24 V d.c., negative grounding.

Universal mobile charger can be used with all car accessories provided for your phone.

Avoid prolonged charging with universal mobile charger when the car engine in not running; this may cause the battery of your car to drain. Note also that in some cars the cigarette lighter plug is not provided with electricity if the ignition is switched off. Verify that the green led light is lit.

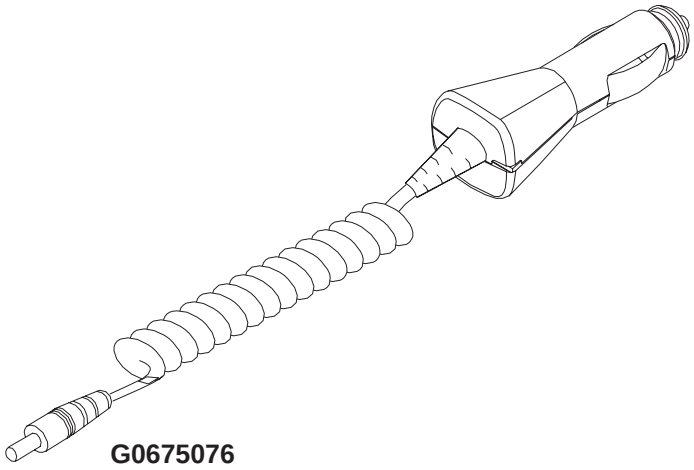
Product Code

Universal mobile charger LCH–6:	*0675076*

Specification

Dimensions (h x w x d):	*29 x 35 x 84 mm*
Weight:	*< 70 g*
Cable length:	*465 mm curly cable*
Connectors	
• input:	*D 21/23 mm*
• output:	*3.0 mm standard d.c. plug*
Protection:	*input fused, output current limit*
Voltage	
• input:	*11.3...35 V*
• output (nominal):	*10.3 V*
Nominal output current:	*780 mA*
Charging into empty battery:	*>= 300 mA*

View of Universal Mobile Charger



G0675076

Fixed Mobile Charger LCM–1

The fixed mobile charger powers your phone from the car battery when the ignition is switched on and leaves the cigarette lighter vacant.

You can use the fixed mobile charger in any vehicle with a 12 or 24 V d.c. connection, negative grounding.

The charging time for the 470 mAh battery is only about 45 minutes.

Fixed mobile charger housing has a four pin connector for power cable, and on the opposite end a connector for the output cable, which connects the fixed mobile charger directly to the d.c. connector of your phone or to the basic hands-free unit.

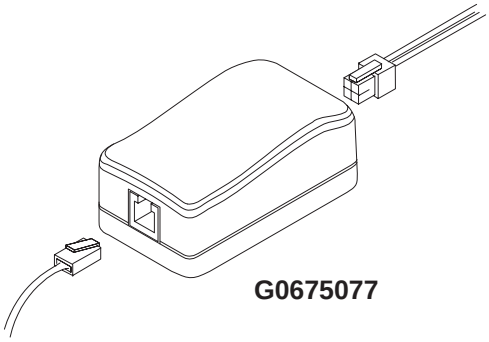
Product Code

Fixed mobile charger LCM–1:	*0675077*
Output cable PCC–1 (supplied with LCM–1):	*0730076*

Specification

Dimensions (h x w x d):	*27 x 36 x 65 mm*
Weight:	*< 70 g*
Output cable length:	*1950 mm*
Protection:	*input fused, output current limit*
Voltage	
• input:	*11.3...32 V*
• output (nominal):	*10.3 V*
Output current nominal:	*780 mA*
Charging into empty battery:	*>= 300 mA*

View of Fixed Mobile Charger



G0675077

Power Cable PCM–5

The power cable connects the fixed mobile charger, LCM–1, to the vehicle's power supply. The red wire must be connected to the + voltage supply controlled by the vehicle's ignition key via the supplied fused connector. The black wire must be attached to a good negative GND connection.

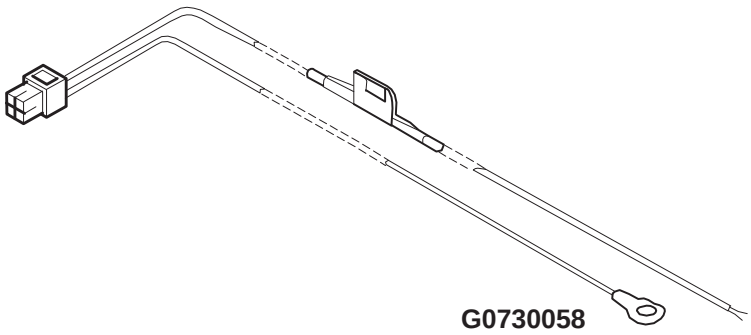
Product Code

Power cable PCM–5:	*0730058*

Specification

Weight:	*74 ±5 g*
Cable length	
• red wire:	*2500 ±100 mm*
• black wire:	*2000 ±50 mm*
Max current via contacts:	*1 A*

View of Power Cable



G0730058

Handset HSU–2

A simple handset with no display or keypad, the handset provides privacy for conversation.

Connect the handset to the bottom of basic handsfree unit PHF–5. The connector is marked with .

When you lift handset from its holder, the HF loudspeaker and HF microphone will be muted and you can speak in privacy. When you replace the handset in its cradle, the call is terminated. However, you can press the Menu selection key of your phone a few seconds before you replace the handset to retain the call and return to handsfree mode.

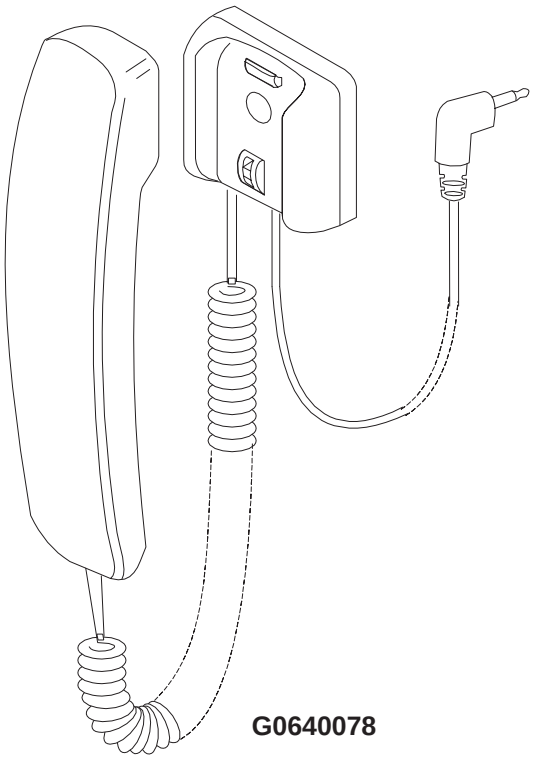
Product Code

Handset HSU–2:	*0640078*

Specification

Dimensions (h x w x d)	
• handset:	*25 x 36 x 181 mm*
• cradle:	*25 x 49 x 54 mm*
Weight	
• handset:	*120 g*
• cradle:	*25 g*
Cable length	
• handset:	*0.4 m*
• cradle:	*2 m*
Handset connector:	*2.5 mm stereo plug*
Input signal level:	*31 mV_{RMS}*
Earpiece sound pressure:	*–7 dBPa*
Microphone sound pressure:	*–9 dBPa*
Output signal level:	*0.85 mV_{RMS}*

View of Handset HSU–2



Headset HDC–2

Compact and functional, headset kit HDXK–7 (headset adapter HDA–4 and headset HDC–2) provides you with a convenient handsfree facility which you can use anywhere.

Connect headset adapter HDA–4 to the bottom of your phone, and plug the headset HDC–2 to the adapter.

In car use, you can connect the headset directly to the basic handsfree unit. (The headset adapter is not required under this configuration.) When used with external antenna adapter, this combination provides you with handsfree operation, privacy and optimum reception quality. When the headset is connected, the HF loudspeaker and microphone are disabled.

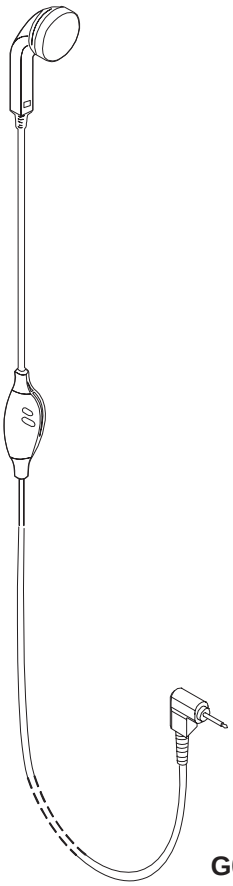
Product Code

Headset HDC–2:	*0694017*

Specification

Cord length :	*1500 ±50 mm*
Weight:	*13 g*
Microphone sensitivity:	*–46.5 ±5 dB (0 dB = 1 V/Pa at 1 kHz)*
Microphone directionality:	*Omni–directional*
Microphone supply voltage:	*5 V*
Earphone rated/max input:	*1 mW/5 mW*
Earphone sound pressure:	*106 ±5 dB (at 1 kHz, 1 mW)*
Impedance	
• microphone:	*max 2.2 kΩ at 1 kHz*
• earphone:	*32 ±7 Ω*

View of Headset



G0694017

Headset Adapter HDA–4

The headset adapter provides connections between the headset, power supply and the phone. The adapter plugs into the base of the phone.

Note: When using the headset adapter, connect your charger to the adapter if you need to charge your phone.

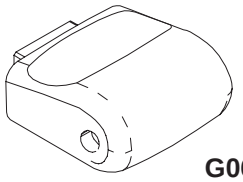
Product Code

Headset adapter HDA–4:	*0694042*

Specification

Dimensions (h x w x d):	*28 x 29 x 13.3 mm*
Weight:	*10 g*
Gain	
• microphone:	*33.5 dB*
• earphone:	*0 dB*
Sound pressure	
• microphone:	*–16...+3 dBPa (0 dBPa = 94 dB spl)*
• earphone:	*0 dBPa...+23 dBPa*
Level at headset connector:	
• microphone:	*1.3...11.6 mV*
• earphone:	*16...220 mV*

View of Headset Adapter



G0694029

Handsfree Microphone HFM–7

The HFM–7 microphone forms part of compact handsfree unit.

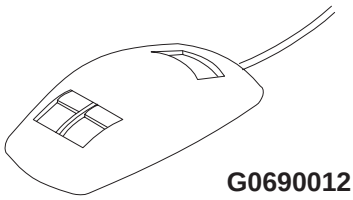
Product Code

Handsfree microphone HFM–7:	*0690012*

Specification

Dimensions (h x w x d):	*16 x 24 x 43 mm*
Cable length:	*3.0 m*
Holders:	*double sided tape and screws*
Connector:	*2.5 mm plug, angle type*
Sensitivity curve:	*hypercardioid*
Bias supply voltage:	*1.5...8 V*
Bias supply current:	*100...500 µA*
Acoustical operating range (THD<1 %):	*35...110 dB SPL (–56...+16 dBa)*
Sensitivity:	*–41±4 dBV/Pa at 1 kHz, front signal (measured with mic assembled on hard plate, 30 x 30 cm)*
Noise (IHF–A weighting):	*<9 µV*

View of Handsfree Microphone



G0690012

External Antenna Adapter AAE–1

The external antenna adapter allows an external antenna to be capacitively coupled to the phone's antenna when the phone is located in the mobile holder. The external antenna adapter is fastened to the top of the holder with two screws.

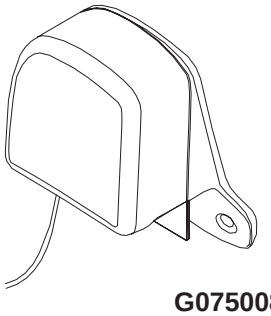
Product Code

External antenna adapter AAE–1:	*0750080*

Specification

Dimensions (h x w x d):	*55 x 40 x 30 mm*
Weight:	*30 g*
Connection:	*Mini UHF/50 Ω*
Cable length:	*750 mm coaxial cable*
Insertion loss:	*< 4 dB*

View of Antenna Adapter



G0750080

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After Sales Technical Documentation

COMPACT HANDSFREE UNIT PHF–5

Original 05/97

NMP Part No. 0275040

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

COMPACT HANDFREE UNIT PHF–5

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Introduction

General

The PHF–5 is a compact handsfree unit for handportable telephones and it provides a possibility to use HF operation. The phone cannot be used as a handset but the PHF–5 can be upgraded with a handset and an antenna coupler. The hook off –signal is given to the phone when a handset is lifted from the hook. The PHF–5 has an internal speaker and external microphone.

Technical Summary

Operation

The PHF–5 can be powered by LCH–6 or LCM–1 rapid chargers to provide rapid charging for the phone also during a HF call. The LCH–8 tricle charger is not recommended for powering the PHF–5 because during a HF call there will be insufficient charging current available for the phone.

The phone is connected to the unit by a system connector. The cable length including the connector housing is 15 cm. The other connectors are d.c. jack (input from the charger), microphone connector and a handset connector. There is no RF connector or external speaker connector in the PHF–5.

The PHF–5 has an internal HF–speaker.

List of Modules

Name of Module:	Material Code:
HF speaker module DH–6	0200658
Assembly parts MPHF–5	0260677

Basic Specifications

Function:	Value:
Input voltage	5.5...11 V d.c. typical range is 6.5...7.5 V with LCH–6
Current consumption	60 mA typical average during HF call
Power source	LCH–6 or LCM–1 charger

Modes of Operation

Power Off

The module does not receive supply voltage from a charger to the d.c. connector. There are no voltages on the module.

Power on/Mute on

The d.c. voltage in the XEAR line is below 0.5 V. There is no audio input signal present. HF speaker amplifier and headset amplifier are muted. The current consumption is below 10 mA.

Power on/Mute off

The d.c. voltage in the XEAR line is above 1 V. If there is no handset connected or the handset is on hook, the XEAR signal is routed to the HF speaker and the HF microphone signal is routed to the XMIC line. If the handset is off hook, the XEAR signal is routed to the handset speaker and the handset microphone signal is passed to the XMIC line.

Modes of Audio Output Destination and Hook

The audio output is routed to handset connector if

- a handset is connected and it is lifted from the cradle
- a headset is connected
- a button headset is connected

Otherwise the audio output is routed to the internal speaker and HF microphone signal is routed to XMIC.

The hook off signal is passed to the phone if audio output is routed to external device. This means that whether a normal or a button headset is connected, the hook is also always off.

Switching Delay between Handset Mode to/from HF Mode

The internal logic for audio routing and hook signal includes a delay, which is to prevent erroneous behaviour of the whole system when switching between modes.

The hook signal for phone is given without any delay.

The audio routing is delayed for about 0.5 seconds, when the audio routing is to change from handset mode to HF mode. The delay is below 100 milliseconds, when the audio routing is to change from HF mode to handset mode.

External Signals and Connections

D.C. Supply Connector X100

Pin:	Signal name:	Function:
1	GND	Ground
2	VCC	Input from charger • min/max voltage: 5.5...10.8 V d.c. • min/typ/max current: 740...780...820 mA d.c. LCH–6 or LCM–1 • min current: 285 mA d.c. LCH–8, not recommended

System Connector X250 (and System Cable Connector X200)

Pin(X200)	Signal name:	Function:
1 (1)	GND	Digital ground
2 (6)	XMIC	Microphone signal • nominal voltage: 60 mV • Id resistor/PHF–5: 22 kΩ to GND • Id resistor/hook off: 22 kΩ to GND
3 (5)	SGND	Signal ground
5 (2)	V_IN	Charge output for phone, connected to VCC • HF call min/typ/max curr: 630...730...810 mA • mute on min/typ/max curr: 730...775...820 mA
6 (4)	XEAR	Speaker signal • typ/max voltage: 60...694 mV • mute on voltage: 0...0.5 V d.c. • mute off voltage: 1...1.6...2 V d.c.
12 (3)	HOOK	Hook off to phone • min/typ/max voltage: 0...0.2...0.4 V pulldown at hook off

HF Microphone Connector X300

Pin:	Signal name:	Function:
1	GND	Ground
2	HFMIC	Microphone signal • typical/max. voltage: 2...30 mV • min/typ/max. bias voltage: 2...3.2...4.4 V d.c. with load

Handset/Headset Connector X400

Pin:	Signal name:	Function:
1	GND	Ground
2	HMIC	Microphone signal • typical/max. voltage: 0.7...15 mV • min/typ/max. bias voltage: 2...3.2...4.4 V d.c.
3	HEAR	Speaker signal • min/typ/max. voltage: 0...60...600 mV with 100 Ω load

HF Speaker Connector X500

Pin:	Signal name:	Function:
1	Speaker +	Speaker positive signal
2	Speaker –	Speaker negative signal

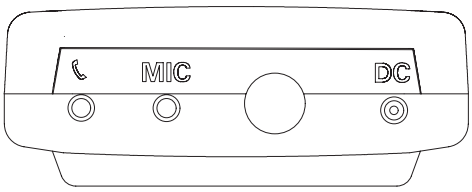
Circuit Description

The circuit blocks are described in these subsections. Refer to block diagram.

Connectors

There are 4 connectors to other units, and internal speaker connector. There are d.c. input, phone bottom connector, microphone and handset/headset connector.

The incoming d.c. voltage is routed directly to system connector VCC pin.



Input Protection

The purpose of the input protection is to prevent ESD, RF and high or negative input voltages to damage the module. Contacts that are subject to ESD are protected with diode pairs. All inputs (as well as test pads) are protected from RF. The RF shield metal plate (assembly part) is the physical interface subject to RF shielding.

CAP interface

This block converts signal levels and also provides single–ended to differential and level conversions as well as hook pulldown and device identification.

Audio In

The circuit performs differential to single–ended conversion of incoming audio signal. The function is: EAR = SGND–XEAR (Gain is 0 dB). Output d.c. bias in EAR line is 2 V, input is a.c. coupled, and the stage tolerates about ±1.5 V combined common mode + differential mode input swing without clipping.

Audio Out

The circuit performs sum operation with minimum phase shift. The function is: XMIC = SGND–MIC (Gain is 0 dB). Input d.c. bias in MIC line must be 2 V, output d.c. is not affected. The stage tolerates about ±1.5 V combined SGND and MIC line swing without clipping.

Device Identification

There is a 22 kΩ d.c. identification resistor connected from XMIC line to GND.

Hook

The circuit pulls HOOK line down when HOOKOFF line is high. The function is: HOOK = –HOOKOFF. There is no pullup in the module.

5 V Regulation

The charger voltage is used as the input voltage for the module, and this block regulates it to 5 V (named +5V in schematic). For low charger voltage input, the maximum drop is 0.5 V so the block is full operative for input voltages downto 5.5 V.

2 V and 4 V Regulation

This block re–regulates the 5 V voltage to high ripple rejection 4 V line (named VSTAB in schematic) and further to 2 V (named +2V in schematic). +2 V is used as half voltage for audio stages and VSTAB is used for microphone biasing and low level microphone amplifier supply voltage.

Speaker Amplifier

This block is s.c. coupled full bridge speaker output stage. It has own 2.4 V half voltage which is seen at both outputs SP+ and SP–. The output swing is 3 V_{RMS} and expected load is 15 ohms. It is possible to use a 8 Ω speaker, too,

but this doubles the power consumption and temperature rise of the IC and therefore it might reduce lifetime. The amplifier is on when HFMUTE is off (below 2.4 V).

Headset Capsule Amplifier

This block is a current booster block that doubles the EAR input voltage but has significant output impedance together with input protection block (100 Ω). The load of the handset is also 100 Ω, so the actual gain is 0 dB for handset. A headset with 32 Ω load impedance gets therefore less power, and the gain is –6 dB. This matches the amplifier output for either device plugged in the handset connector. Maximum output voltages are 550 mV_{RMS} for handset and 225 mV_{RMS} for headset, seen at the handset connector with 110 Ω and 32 Ω loads, respectively. The amplifier is on when HSMUTE is about 5 % below the +2 V line level. The amplifier is off when HSMUTE is below 0.7 V. Levels between these are forbidden (except level transients) and lead to distorted output.

HF Microphone Preamplifier

This block is used for high performance preamplifying of the HF microphone signal. The mic is biased from VSTAB in this block. VSTAB is also used as a supply voltage for the amplifier. The block is used also for level matching between the two mic inputs, as they have common amplifier/selector stage (Microphone amplifier). The gain is 10 dB, input impedance is 2 kΩ. The output d.c. voltage is around 0.6 V, but when tied to GND by microphone amplifier block, the amplifier is disabled.

Handset Microphone Preamplifier

This block is used for high performance preamplifying of the handset microphone signal. The mic is biased from VSTAB in this block. VSTAB is also used as a supply voltage for the amplifier. The block is used also for a.c. level matching between the two mic inputs, as they have common amplifier/selector stage (Microphone amplifier). The gain is 17 dB, input impedance is 2 kΩ. The output d.c. voltage is around 0.6 V.

Microphone Amplifier

This block is used as a microphone selector and is also postamplifies the signal providing the low output impedance MIC signal for the CAP interface block. The two mic inputs are a.c. coupled and the output (MIC line) is biased to 2 V. The EXTAUD line is used for input selection. When the EXTAUD is high, the HF microphone line is tied to GND, which disables the whole HF microphone preamplifier block increasing rejection in handset mode. When the EXTAUD is low, the handset microphone amplifier block is operative but it cannot have any signal.

The gain in this stage is 20 dB for both of the input signals.

Hookoff Sense

This block monitors the handset microphone current and provides HOOKOFF and EXTAUD signals. The current of the 2.2 kΩ bias resistor of the handset microphone preamplifier block is monitored (by monitoring voltage drop) and if the d.c. resistance of the handset microphone is less than about 50 kΩ, the HOOKOFF line is tied high (above 3 V), othervise low (below 0.1 V). The EXTAUD line is following the HOOKOFF line, with RC time constant of 470 milliseconds.

The 50 kΩ d.c. impedance in the handset microphone corresponds to about 80 mA. If a handsfree microphone is plugged to handset plug, the block will identify this as a handset or headset, and the audio output is shorted by the mono plug of the HF microphone.

Muting Logic

This block monitors the XEARP and EXTAUD lines, and gives the HFMUTE and HSMUTE signals, that switch the speaker and handset capsule amplifiers to correct modes. This block is extremely level–sensitive and it does not have simple ”0” or ”1” input or output signals.

The XEARP d.c. level is monitored, and if the d.c. is below 0.7 V, both outputs will be in mute state regardless of the EXTAUD state. If the XEARP d.c. is above 0.7 V, the circuit creates internal reference level of 0.5 V, and decision is made using the EXTAUD signal; if EXTAUD is above 0.5 V, the HSMUTE will be off, and HFMUTE will be on. If XEARP d.c. level is above 0.6 V and EXTAUD is below 0.5 V, then HFMUTE will be off and HSMUTE will be on.

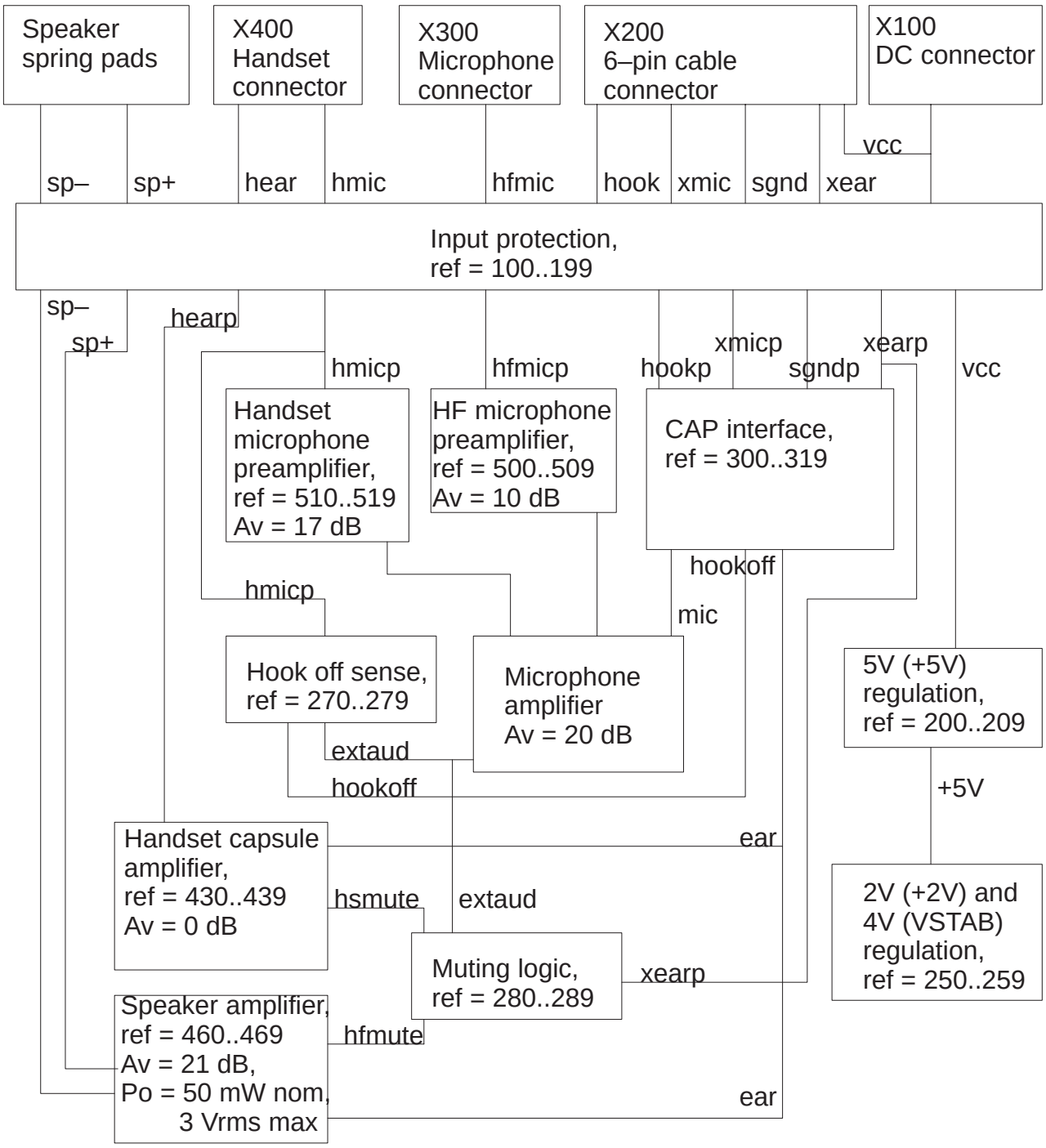
The HFMUTE signal on–level is above 3 V and off–level is below 0.7 V (When HFMUTE is on, the speaker amplifier is in shutdown).

The HSMUTE signal on–level is below 0.1 V and off–level is 5 % below +2 V line level. There is a RC time constant of 0.1 seconds when changing between these levels.

Power and Control Line Usage of Blocks

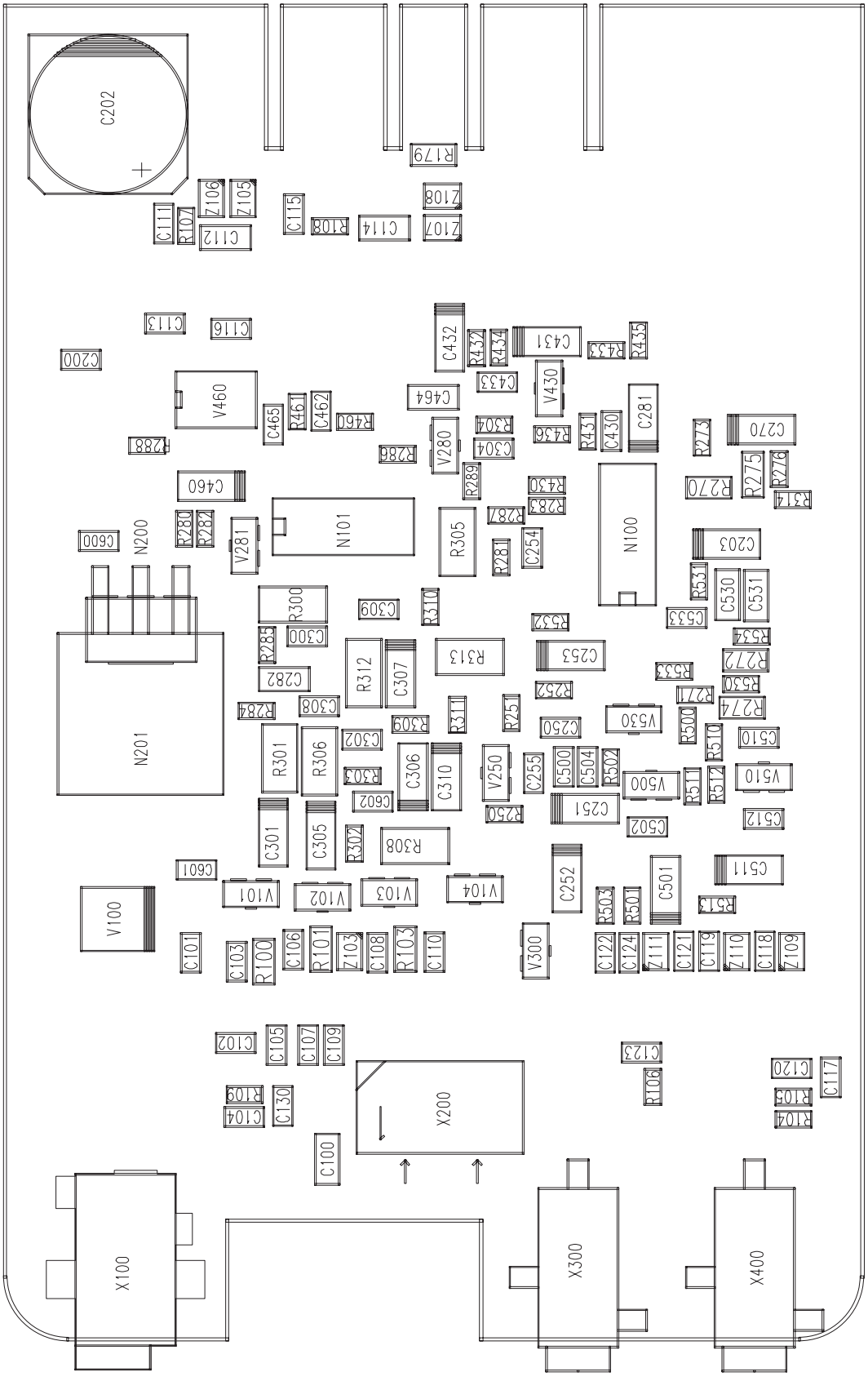
Block:	Power line:	Bias voltage:	Control lines:	Notes:
Input Protection	Diode pairs to VCC & GND	–	–	
CAP Interface	+5 V	+2 V	HOOKOFF	
5 V Regulation	VCC	–	–	Gives +5V line out
2 V and 4 V Regulation	+5 V	–	–	Gives VSTAB and +2V lines out
Speaker Amplifier	+5 V	internal biasing	HFMUTE	
Handset Capsule Amplifier	+5 V	+2 V	HFMUTE	
HF microphone preamplifier	VSTAB	VSTAB for mic, internal biasing	–	output pulldown will lead to shutdown
Handset microphone preamplifier	VSTAB	VSTAB for mic, internal biasing	–	output pulldown will lead to shutdown
Microphone Amplifier	+5 V	+2 V	EXTAUD	
Hookoff sense	+5 V	VSTAB	HMICP	Gives HOOKOFF and EXTAUD lines
Muting logic	+5 V	+2 V	XEARP, EXTAUD	Gives HFMUTE and HSMUTE lines

Block Diagram



Circuit Diagram of DH6 (Versio 12 Edit 148)

Layout Diagram of DH6 for layout version 12



Part List of DH6 (EDMS Issue 7.0 Code: 0200658))

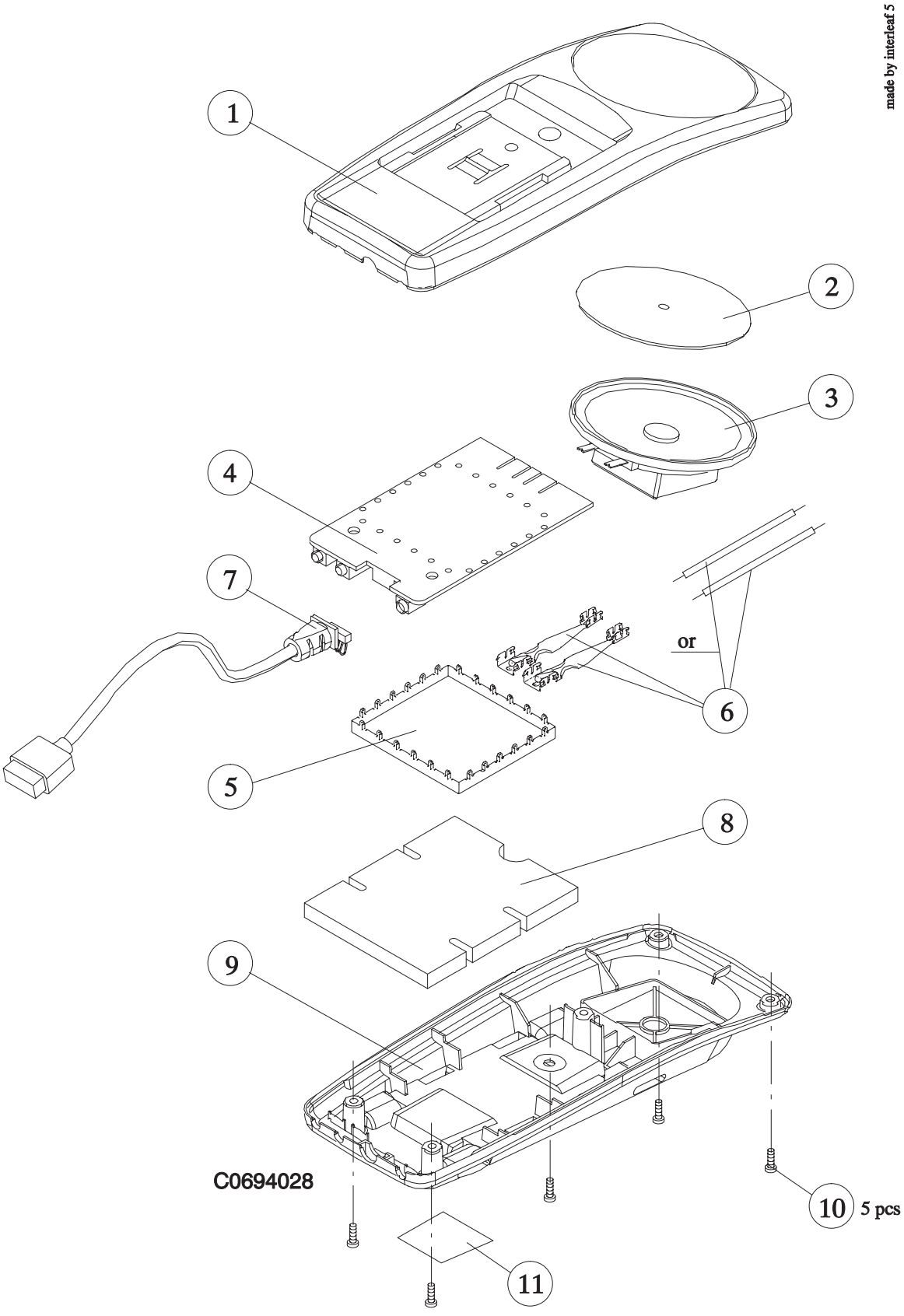
ITEM	CODE	DESCRIPTION	VALUE	TYPE
R100	1413836	Chip resistor	47	5 % 0.1 W 0805
R101	1413836	Chip resistor	47	5 % 0.1 W 0805
R103	1413836	Chip resistor	47	5 % 0.1 W 0805
R104	1430167	Chip resistor	47	5 % 0.063 W 0603
R105	1430167	Chip resistor	47	5 % 0.063 W 0603
R106	1430167	Chip resistor	47	5 % 0.063 W 0603
R107	1430151	Chip resistor	10	5 % 0.063 W 0603
R108	1430151	Chip resistor	10	5 % 0.063 W 0603
R109	1430053	Chip resistor	5.6 k	5 % 0.063 W 0603
R179	1413924	Chip resistor	220	5 % 0.1 W 0805
R250	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R251	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R252	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R270	1414536	Chip resistor	200 k	1 % 0.1 W 0805
R271	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R272	1414536	Chip resistor	200 k	1 % 0.1 W 0805
R273	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R274	1414536	Chip resistor	200 k	1 % 0.1 W 0805
R275	1414536	Chip resistor	200 k	1 % 0.1 W 0805
R276	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R280	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R281	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R282	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R283	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R284	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R285	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R286	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R287	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R288	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R289	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R300	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R301	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R302	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R304	1430053	Chip resistor	5.6 k	5 % 0.063 W 0603
R305	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R306	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R308	1415939	Melf resistor	22.1 k	1 % 0.2 W 0204
R309	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R310	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R311	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R312	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R313	1415696	Melf resistor	2.21 k	1 % 0.2 W 0204
R314	1430065	Chip resistor	10 k	5 % 0.063 W 0603

R430	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R431	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R432	1430167	Chip resistor	47	5 % 0.063 W 0603
R433	1430167	Chip resistor	47	5 % 0.063 W 0603
R434	1430167	Chip resistor	47	5 % 0.063 W 0603
R435	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R436	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R460	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R461	1430091	Chip resistor	150 k	5 % 0.063 W 0603
R500	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R501	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R502	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R503	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R510	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R511	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R512	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R513	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R530	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R531	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R532	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R533	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R534	1430095	Chip resistor	220 k	5 % 0.063 W 0603
C100	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C101	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C102	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C103	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C104	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C105	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C106	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C107	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C108	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C109	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C110	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C111	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C112	2312208	Ceramic cap.	15 n	10 % 50 V 0805
C113	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C114	2312208	Ceramic cap.	15 n	10 % 50 V 0805
C115	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C116	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C117	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C118	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C119	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C120	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C121	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C122	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C123	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C124	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C130	2320077	Ceramic cap.	560 p	5 % 50 V 0603

C200	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C202	2517848	Electrol. cap.	220 u	20 % 16v8.5x8.5x10.5
C203	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C250	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C251	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C252	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C253	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C255	2320091	Ceramic cap.	2.2 n	5 % 50 V 0603
C270	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C281	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C282	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C300	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C301	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C304	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C305	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C306	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C307	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C308	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C309	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C310	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C430	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C431	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C432	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C433	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C460	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C462	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C464	2312208	Ceramic cap.	15 n	10 % 50 V 0805
C465	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C500	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C501	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C502	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C504	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C510	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C511	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C512	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C530	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C531	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C533	2320063	Ceramic cap.	150 p	5 % 50 V 0603
Z103	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z105	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z106	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z107	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z108	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z109	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z110	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
Z111	3640011	Filt z>600r/100m 0r6max 0.2a 0805		0805
V100	4113828	Trans. supr.	SMBJ28A	DO214AA
V101	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23

V102	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V103	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V104	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V250	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V280	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V281	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V300	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V430	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V460	4340303	IC, af amp 0.5w 2.7–5.5v so	LM4861	SO8S
V500	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V510	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V530	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
N100	4301182	IC, 2 x op.amp.	LM2902	SO14S
N101	4301182	IC, 2 x op.amp.	LM2902	SO14S
N200	4340065	Mic5201 regld 5v 0.2a 1% sot223		SOT223
X100	5409003	SM, jack 3.0mm f dc 9v 1a		
X200	5409015	Pin header 1x6 p1.5 0r02 1a 50v		
X300	5400017	Jack 2.5mm stereo sm		SMD
X400	5400017	Jack 2.5mm stereo sm		SMD
	9854073	PCB DH6 83X54X1.6 D 4/PA		
	9854073	PC board	DH6	83x54x1.6 d 4/pa

Exploded View



Assembly Parts

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1		9450571	Front cover	DMD00055
2		9480214	Dust shield	DMD00068
3		5140013	Loudspeaker 1W 15R	D64MM H19MM
4		0200658	HF speaker module	
5		9510259	RF shield	DMD00052
6 or	2	710F000	Connectin wires	
6	2	9510260	Connecting spring	DMD00051
7		9780145	Compact HF cable	4C 24532
8		9480212	Acoustic foam	DMD00067
9		9450570	Back cover	DMD00054
10	5	6291928	PT screw KB25X7	WN1412 FeZn blk
11		9380154	Label blank	4D22419 23.8X17.5

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